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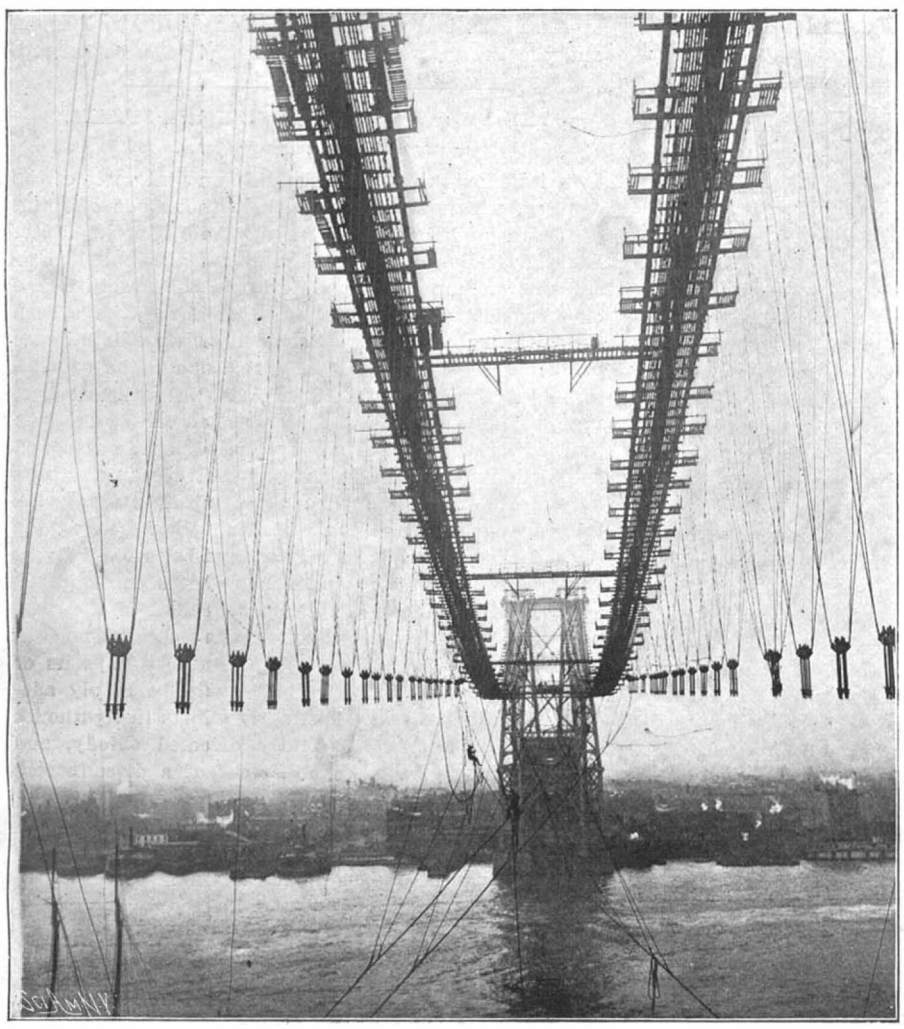
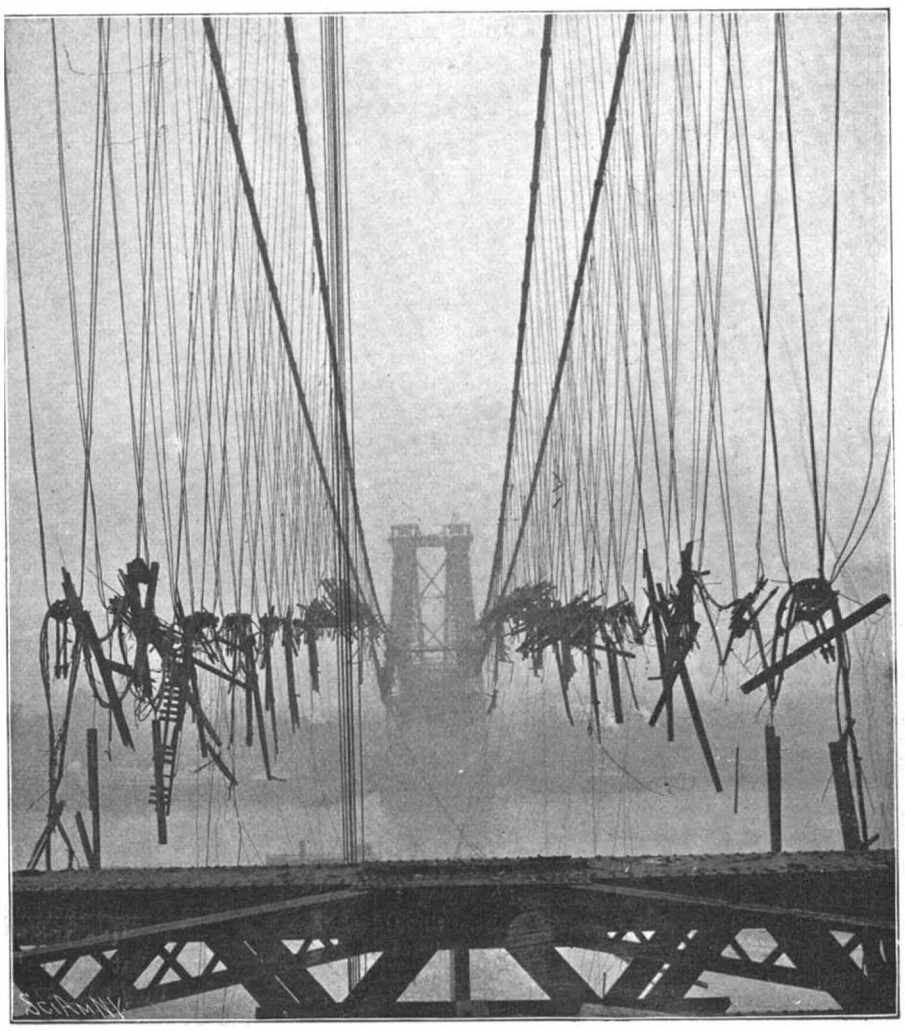


View Before the Fire, Showing Footbridges, and Suspenders in Place.



View From Same Position After the Fire, Showing Wreck of Footbridges.

THE NEW EAST RIVER BRIDGE AFTER THE FIRE. THE MANHATTAN [illegible] ER, WHERE FIRE OCCURRED IS IN THE FOREGROUND.—[See page 344.]

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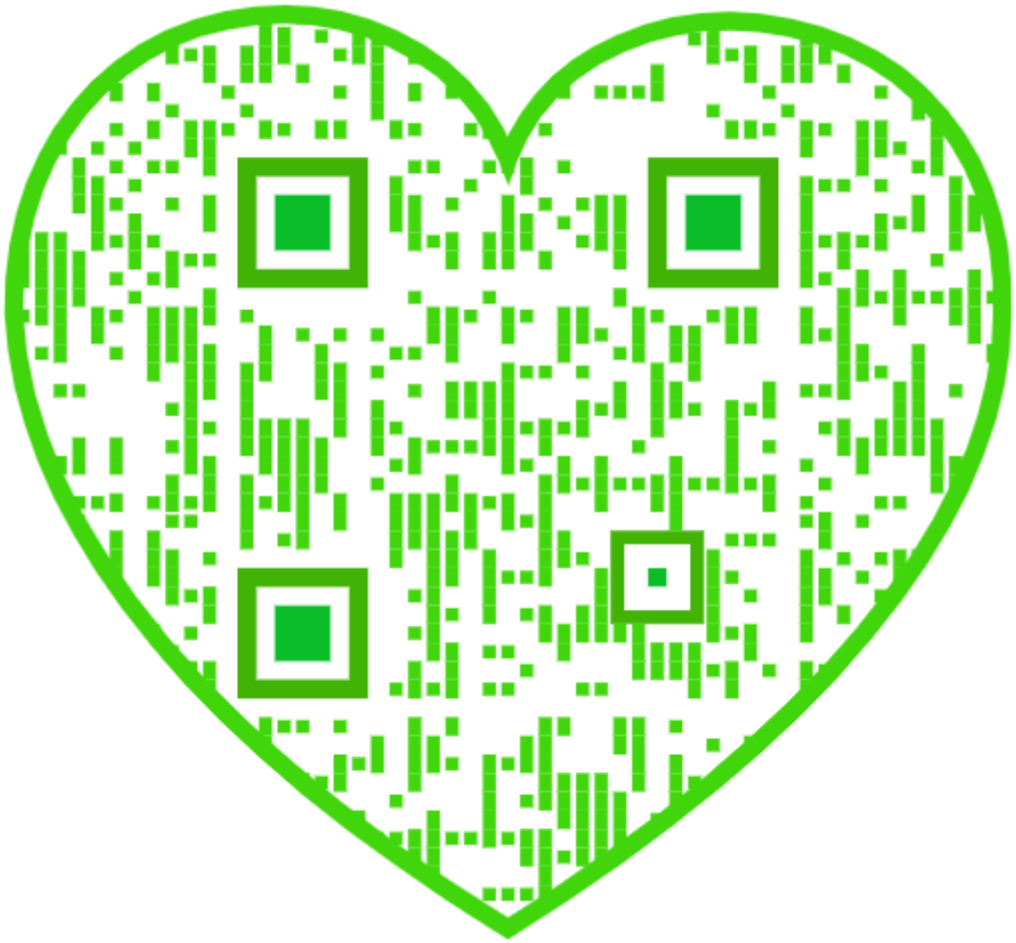

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NEW YORK, SATURDAY, NOVEMBER 22, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE LESSON OF THE EAST RIVER BRIDGE FIRE.

The recent East River Bridge fire will not be without its useful effect if it results in provision being made for fireproofing the completed structure. Of all the risks incidental to a great work of this kind, the very last that anyone seems to have considered was that of fire. It is easy to be wise after the event, but it is a matter for regret that, in preparing the temporary saddles for carrying the footbridge cables and supporting the strands of the main cable during erection, the Roebling Company did not build them of steel instead of timber. The cost would have been very little more, and the disaster which occurred would have been rendered impossible. At the same time, the accident teaches a very obvious lesson with regard to the future work on the bridge; for, if the existence of a structure costing from $20,000,000 to $22,000,000 is liable to be threatened by the use of combustible material in its construction, obviously the builders of the bridge should be careful to eliminate as far as possible all material that would cause a serious fire. As at present designed, the construction of the roadways, footways and railroad tracks calls for the inclusion of several million feet of timber. The existence of this material, high up in midair, where it is exposed to the full force of any wind that is blowing, will be an invitation to a disaster compared with which the fire of last week would be insignificant. Should the mass of timber in the roadway floorings, or in the railroad ties of the elevated and trolley tracks, once become thoroughly ignited, the fire would be liable under the influence of a strong breeze to sweep with great velocity and fierceness throughout the whole length of the bridge. To guard against fire two precautions should be taken: the amount of timber should be reduced to a minimum, while such as is used should be thoroughly fireproofed, and this protection should be further strengthened by the laying of ample water mains across the bridge with frequent hydrants. The use of fireproof wood would, of course, be costly; but viewed as an insurance upon the structure, it is an expense that would be justified by every consideration of prudence and economy.

PIPE GALLERIES FOR THE BROADWAY TUNNEL.

We understand that the City Controller at the last meeting of the Rapid Transit Commission moved that the Chief Engineer be instructed to prepare alternative plans, one of which will provide for pipe galleries along the Broadway line leading to the Brooklyn tunnel. It is the hope of the Controller that the city may be able to furnish the money necessary for the construction of these galleries. The announcement of this most important fact formed an insignificant paragraph in the daily press of the city that probably escaped the notice of a majority of its readers. Yet it is a fact that the question at issue has more to do with the comfort of the citizens of New York than many other municipal questions that receive, and will receive, far more attention. It cannot be denied that the water and gas mains and electric cables that underlie the streets of New York are the source of more interruption to traffic, more dirt and general confusion, than any other cause, unless it be the erection of new buildings. Whenever a main gets out of order, whenever the existing mains become too small for the needs of the city and have to be replaced by larger mains, whenever new connections, however small and insignificant, have to be made between a building and the street mains, the surface of the street is broken up, an unsightly and very obstructive excavation is made, and, as if the disturbers of public comfort rather gloried than otherwise in their work, when the excavation is closed the dirt is roughly thrown in, and it is usually weeks before the original granite or asphalt surface is restored. And this is going on every day of the year, and in a thousand different places at once.

With the construction of the Rapid Transit Subway it was realized by the engineers that there was a great opportunity presented for solving this problem by gathering all the city mains, conduits, cables, etc., together, and placing them in galleries constructed at the side of the Rapid Transit Tunnel. Plans were drawn for these galleries, and they were so arranged, with proper manhole openings at intervals, that whenever any repairs, laying of mains, making connections to buildings, etc., had to be done, the gallery could be entered at the proper manhole and the work done without any disturbance whatever of the city's streets. On some stretches of the Rapid Transit subway excavation was made for these galleries; but owing to a most disgraceful political move on the part of the Tammany politicians who were in power at that time, two or three heads of departments raised a series of obviously absurd and inadequate objections to the plan, with the result that the Rapid Transit Commission, rather than become involved in a legal controversy that might seriously delay the work, decided to go ahead with the tunnel and drop the subway scheme altogether. As a consequence, the city mains have been spread over the roof of the tunnel, a foot or so below the surface of the ground, and the city will continue to be exposed to the same interminable interruptions of traffic, which will be all the more exasperating because they could easily and cheaply have been avoided. In the construction of the subway down Broadway to the Brooklyn tunnel an opportunity is presented for putting in the pipe galleries and ridding this important and crowded thoroughfare of the street main nuisance. According to the City Controller, the erection of the galleries is now a question of finance; and we suggest that if this is the only consideration that stands in the way, it would be well to sacrifice some other and far less necessary city improvements in order to insure the carrying through of this greatly needed work. We commend the subject to that most enterprising body the Merchants' Association, which, we believe, in times past has itself directed attention to this important question. The subject is a pressing one, and unless favorable action be taken at an early date, an opportunity will be lost, as regards our most important thoroughfare, which will never return. For it would be a more difficult and costly matter (if not in some cases impossible) to build the subways after the structure of the tunnel has been completed.

A RESULT OF IMPROVED RAPID TRANSIT.

The remarkable increase in travel shown in the annual report of the Manhattan Elevated system is another proof that it pays the great transportation companies of this city to spend large sums of money in the betterment of their tracks and rolling stock. Also, it may be noted that the statistics of travel on this road for the past eight or ten years prove with equal clearness that it does not pay a great railroad system to lag behind in the matter of improvements, trusting to its prestige and the great needs of the traveling public to maintain its volume of traffic. During the year ending September 30, 1902, the Manhattan Elevated system carried a total of 223,427,283 passengers as against 194,152,316 carried during the preceding year. This great increase is to be attributed to the change which the company has made during the past year from steam to electric traction, with its resulting advantages of improved cars, better lighting, higher speed, more frequent service, and generally increased comfort of travel. The electric equipment of the Manhattan system was a very costly undertaking; yet the results of the first year of travel under the improved conditions show that the outlay was more than justified. It may surprise the public to learn that this great increase serves merely to bring the total of railroad travel about up to the figure at which it stood in 1893, when over 221,000,000 passengers were carried. In the following year there was a marked decrease to 202,751,532 passengers, and to explain this we must remember that at that time the Metropolitan Street Railway Company, or its predecessor rather, commenced the substitution of cable traction for the old and slow horse cars. This improvement of the surface system immediately began to attract passengers from the Elevated road, which made no effort whatever to meet the competition. A still further decrease of travel occurred in the year 1898 to 1899, when the enterprising Metropolitan Street Railway Company began to open that vast system of electric railroads which now embraces the whole city, the cable system and many of the horse car lines being replaced by electric traction. The figures of travel on the Elevated railroad since 1894, stated in millions of passengers, are for 1895, 187 millions; 1896, 184 millions; 1897, 182 millions; 1898, 183 millions; and the low-water mark was reached in 1899, when the total fell to 174 million passengers; the passenger earnings being $8,704,000 as against a total of $11,000,000 earned in 1893. In 1900 there was an upward movement manifest, the total number of passengers being 184,000,000, and this increased, as we have seen, to over 223,000,000 in 1901. These figures are all the more significant when we remember that only one-half of the elevated system's lines are completely equipped with electric traction, and consequently the travel for the year 1902-3 will probably be very much greater than this. One of the most valuable advantages of the improved conditions is the fact that on account of the greater frequency of the train service and the increased length of the trains, this great increase in the passenger traffic is taken care of with less crowding than when there was a smaller volume of travel. With the opening of the Rapid Transit Subway at the close of next year, there will probably be a movement from the elevated to the subway trains, and we may look for a corresponding decrease of travel on the elevated system. So rapid, however, is the growth of New York city, that it will not be two or three years before both the elevated and subway systems, especially on the express trains to Harlem and the Bronx, will be taxed to their full capacity.

THE NEW AMERICAN LIGHTHOUSE SYSTEM.

BY GEORGE ETHELBERT WALSH.

In its efforts to protect the shipping interests of the country, which stretch over some thousands of miles of ocean and inland waterways, the United States Lighthouse Board has in recent years accomplished results of an unusual nature, and, in the practical and experimental work performed, reliable data have been collected that must throw some light upon lighthouse problems in other countries. From one of the poorest-lighted coasts, the American Atlantic seaboard has, within a quarter of a century, become one of the best in the world, and the new system of lighthouses and signal lights is far more comprehensive than anything heretofore attempted. The problem of lighting the immense stretches of coast bordering two oceans, the Great Lakes, the Gulf of Mexico, and the inland rivers and waterways, was a stupendous one to contemplate. There was, in fact, so little comprehension of the magnitude of the enterprise that for many decades no idea was entertained of attempting to establish a system of lights, beacons and buoys that would be amply adequate for all purposes. The early efforts in lighthouse construction were consequently directed chiefly, and almost solely, to the establishment of a disconnected and irregular system, which would protect the shipping world only in certain dangerous places.

In this early development of the work, the coasts were divided into zones with certain important dangerous points marked plainly for lighthouse protection. The Cape Hatteras region, and the scarcely less important Cape Cod district, early received special attention. Both of these capes were in the direct route of commerce, and the storms and shoals that made them dangerous to navigators had to be offset by adequate lights which would warn mariners of their proximity. The first attempts at lighthouse construction were consequently made at a few such dangerous points along the coast, and from these in either direction new lights were gradually erected. They formed the beginning of the new system which seeks to make all of our coast so well protected that navigators need have little apprehension in approaching the land from any direction at any point.

But the rapidly increasing commerce on both the Atlantic and Pacific seaboard has made in recent years a more comprehensive system of lighthouses imperative. Likewise the shipping interests of the Great Lakes, the Gulf of Mexico, and the great inland rivers, have multiplied in importance, and the need for better protection from dangers to navigation has been general. For a quarter of a century now the American lighthouse system has expanded and developed, until it has reached a point in its evolution where it is without question one of the best in the world. The enormous coast line of the United States is now actually connected at every point with these modern "aids to navigation," and the seaman who knows his chart well has little difficulty in finding his way on the stormiest nights.

The full extent of the lighthouse service can best be appreciated by simply stating that there are some 9,000 warning lights and signals stretched along the American coasts, forming a perfect link so that the navigator need never be beyond the sight of one of the beacons. Of this grand total—including lighthouses of different classes, buoys, beacons, and danger signals—over 3,000 are lighted, giving forth their signals at night time. One thousand of these lights are located on the Atlantic coast, 1,500 are scattered along the rivers and inland waterways, 500 on the Great Lakes, and 200 on the Pacific coast. These so-called lighted "aids" include a great variety of modern inventions, from the tall flashlight lighthouse, with its base of steel and stone, and costly lamp operated by electric power, to the modern gas and electric-lighted buoys, beacons and lightships. There is such a variety of different lights included in this list that detailed description of them would fill volumes. The advances made in lighthouse and buoy construction represent some of the marvels of modern engineering science.

From time immemorial lighthouse construction has

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been one of the most intricate and difficult of engineering problems. The destructive effects of the sea and storms upon the foundations of these buildings early proved disastrous, and in the history of the science many unfortunate failures have been recorded. The need of a lighthouse at critical points has generally been almost in direct proportion to the difficulties of constructing such a building. Shifting sands have always formed insecure foundations for high buildings, and when these were aggravated by heavy seas and universal storms and winds the problem was intensified. Even the construction of a tall lighthouse on the sandy beach some distance back from the sea was not always a matter of easy engineering work. The encroachment of the sea upon the land in many places slowly undermined the foundations until they had to be strengthened or abandoned. One of the most effectual ways to protect the lighthouses on our sandy coasts adopted in recent years has been to build dykes of piles and brush far out into the sea for the purpose of making the ocean build up rather than tear down the beach. The tides and currents of the ocean, eddying in at particular points on the coast, would slowly wash away the beach and destroy it; but by constructing the dykes in the water these same destructive currents contributed to build up the land. When the tide laden with fine, loose sand strikes the brush anchored between the rows of piles, it either deposits the sand in passing through the obstruction, or collects it in a heap just where the angle is formed by being forced to one side by the brush. Slowly but surely land is thus formed. Half a dozen lighthouses along the Southern coast have been saved from total destruction in this way. Several of them, which a dozen years ago stood perilously near the edge of the water, now stand five hundred yards back from the tumbling ocean.

Even the best modern engineering has not yet been able to make the shifting sands a secure and permanent foundation for heavy structures. The difficulty of digging down into the sand for a secure foundation is sometimes attended by unexpected developments and obstructions that render the work almost of no avail. Forty and fifty feet below the sands nothing but soft, shifting quicksands have frequently been discovered, and the site of the new structure has had to be abandoned as a result. The difficulty of finding the right sort of foundation on the low sandy coast of our Southern States has consequently made lighthouse building more intricate in detail than along the rocky New England shore. Some of the most perplexing engineering problems have been solved in that part of the country.

One of the most noted advances in modern times has been the abandonment of the old towers of stone or brick and the adoption of the steel tubular structures in their places. The latter are built more easily on a solid, rocky foundation than the old huge piles of masonry. The steel skeleton is bolted into the solid rock or anchored there by means of long spindle-like legs, which sink many feet down into the firm foundation. These huge cylindrical towers of steel withstand the pressure of wind far better than the stone and brick structures, and their strength is so great that there is practically no danger of their ever being seriously injured by the elements. Even where the lighthouses are built in the water to mark shoals or dangerous reefs, the steel tubular style of structure is adopted. The foundation work of the structure is built up above the water with stone or concrete, and to this the steel tower is bolted. The latter looks more like a giant smokestack than anything else, and it stands as a permanent beacon of the sea to warn mariners of their danger.

Not only is additional strength and security obtained through the adoption of the steel tubular lighthouses, but the cost of construction is greatly reduced. Modern lighthouses cost far more than they did in former days, but that is due to the fact that they are built on a larger and more enduring scale, and the lights are of far greater power and intensity. A modern American lighthouse frequently costs $125,000, and often one-third of this is spent in the electric light and apparatus alone. In the old system the lights represented a comparatively small proportion of the expense. The finest French mirrors and lenses used were considered costly, but not in comparison to the electric lights and equipments. The gain obtained in the power of the light more than counterbalances the extra cost. There are a score or two of lighthouses in existence whose lights throw a beam of 100,000 candle power. The tendency is to increase the power of the lights, for by so doing the great link of lighthouses is made more secure and more trustworthy.

To maintain the lighthouse service a corps of over 4,000 men is constantly employed, and a fleet of more than fifty vessels. These latter are required to make periodical visits to the different lighthouses, light ships, and buoys, carrying supplies to the men and inspecting the lights in the interests of the department. The lighthouse keepers receive on an average $600 a year for their services. With the salaries of the crew, coal and provisions, it costs the government about $6,000 a year to maintain a first-class lightship, and about $500 a year for each of the 5,000 buoys scattered along the coast. At present the sum of nearly $750,000 is required to pay the lighthouse service men who watch the lights, tend the buoys, and live their solitary existence on the lightships. The service is altogether well handled, and as efficient as it is possible to make it, while the keepers and crews are as enthusiastic in their work as any body of men in the world.

THE PHYSIOLOGY OF CERTAIN COLORS.

BY JAMES WEIR, JR., M.D.

Havelock Ellis, several months ago, had an article on "The Psychology of Red" in Popular Science Monthly, in which he showed that red has an unmistakable effect on the psychical organism. Incidentally, he also demonstrated the fact that color has likewise a physical effect both upon plants and upon animals. He does not, however, discuss the physiological causes for each effect. It is the purpose, therefore, of this brief paper to bring out the probable action of color on the basic principles of life as far as we know them.

Thousands of years ago, it was noticed that plants reared in darkness were colorless and of weak and fragile habit. It was also observed that men who passed their lives in darkness or semi-darkness were not as robust as those who lived in the light of day. So the general conclusion was reached very early in the history of the world, that the light of the sun directly influenced both animal and plant life.

Recently, it has been determined that the rays of the sun exert dynamic, chemic, and physiologic effects on the *vis vitæ* of plants and animals. The three forces through which the rays of the sun act, viz., the dynamic, the chemic, and the physiologic, are, to a certain extent, intercorrelated; therefore, they must be studied together.

It will hardly be necessary to point out the fact that white light or daylight is a combination of all of the primary colors, violet, indigo, blue, green, yellow, orange, and red. It is highly important to my thesis, however, to demonstrate that certain of these colors exert a selective or elective influence on the physiology of animate organisms, and, individually, affect such organisms in some degree.

Flammarion's beautiful experiments at the climatological station at Juvisy, have shown beyond question of doubt, the widely different effects of the red and violet rays on plants. The plants chosen were of the genus *Mimosa* or "Sensitive Plant," and were subjected to the same environments with the exception that some were reared beneath dark blue glass, and others beneath red glass.

In four months, the plants grown under the red glass had attained extraordinary development, while those subjected to the violet rays had made no progress whatever. Similar effects were noted in the case of strawberries, and numerous other vines, plants, and shrubs.

The plants grown beneath blue glass did not die, but seemed to remain in a dormant condition without growth or further development.

Zacharawietz, of Vaucluse, has also shown that plants are strongly affected along the lines of rapid growth and development by red and orange rays. As early as 1883 I demonstrated and published the fact that typhoid fever germs would not live when subjected to the blue or violet rays.

Ward, Finsen, Berghold and others have shown that the blue, violet and ultra-violet rays are fatal to bacteria and that the other colors are not, while Finsen has made successful use of this knowledge in the treatment of zymotic skin diseases, such as smallpox, measles, and scarlatina. It would appear from these observations that the red and orange rays have a distinctly favorable physiological action on plants, while the blue, violet, and ultra-violet rays are as distinctly deleterious.

When we come to observe the action of the violet rays on animal life, we see that such action is, apparently, markedly different from that to be observed in vegetable life. But, as Davenport has pointed out, this difference is more apparent than real; for these effects on animal and plant physiology are due to the same chemical metabolic changes, but, "while plants succumb to the influence of the violet rays, animals, being more highly organized, are able to take advantage of them and flourish."

In 1883, while studying tinctumutation or the color-changing function in certain animals, I reared a large number of newts, or salamanders, from the eggs. The eggs were placed in shallow vessels which were covered by colored glasses, blue, orange, green, and red.

The eggs under the blue glass hatched out first; under the orange, second; under the red, third; and under the green, last of all. The young larvæ under the red glass were much more active, at first, than those under the other glasses, and attained full maturity several days earlier. The larvæ under the blue glass, however, grew to be much larger and in the end were much stronger and more agile. Under the green glass, the larvæ were sluggish, and of slow growth. I noticed, moreover, that whereas there were no monstrosities or deformed animals under any of the other glasses, there were many under the green and the orange glasses.

The animals under the blue glass were distinctly darker than those under the other glasses, and, under the microscope, the chromatophores, or color-bearing cells, were seen to be much more numerous.

The violet, and ultra-violet rays have a pronounced chemical as well as physical effect on the human body. They have, also, in all probability, a dynamic effect, which is shown by the feeling of well-being or otherwise. The "summer girl" who, in the early days of her vacation, cannot stand the sun, will, in the middle of summer, welcome the embraces of Phœbus Apollo and will revel in his kisses! She says that she has become accustomed to the rays of the sun and that she no longer feels them because it has become her "habit to walk abroad without hat, parasol, or umbrella." Thus she gives credit to the wrong agent; for her feeling of well-being is not due to habit, but to the thin brown veil of tan which the violet rays with ever-busy brush have spread out on the surface of her body wherever it has been exposed to them. The violet rays thus erect a barrier against themselves, for they cannot pass the tan. Nature always takes care of her children, that is, if they will give her time, and do not, in their ignorance, attempt to hasten her!

It is true that, primarily, the violet rays are superficial in their effect; yet they are, nevertheless, sometimes destructive in a high degree. Ask the boy who awakes in the night after an afternoon in the river, and "moans, and moans, and moans" on account of the intolerable fire between his shoulder blades, what *he* thinks of the ultra-violet rays; or, ask the blind and helpless traveler who stumbles across the weary waste of Arctic snows what *he* thinks of them? Both sunburn and snow-blindness are due to the violet and ultra-violet rays.

Yet, the violet rays are absolutely necessary in the up-building of the normal, healthy man. Their action must be, I take it, primarily through stimulation of the vaso-motor nerves, i. e., the nerves which control blood-vessel action. The first effect is dynamic in character; there is dilatation of the blood vessels with a consequent increased flow of blood. The second effect is chemical in nature; the increased flow of blood incites the blood-producing organs to manufacture new blood-cells, consequently the plasma of these cells differs chemically from the plasma of the old cells. There is, also, increased oxidation and oxygenation due to increased flow of blood through the lungs. The third effect is purely physiological. Owing to the increased flow of new blood cells to the tissues, cell growth is excited and new tissue is formed. Of course, waste is going on all the time; the violet rays merely act as a tonic in stimulating the organs of the animal economy toward repairment of waste by renewing and building up tissue. These beneficial rays are present in diffused daylight, hence the direct rays of the sun are not absolutely necessary in order to produce their good effects on the animal organism. Direct sunlight is, however, an exceedingly efficacious tonic when used moderately and understandingly; there can be intemperance, however, in the use of every good that Nature has given us.

TWO NEW WARSHIPS FOR CHILE.

Remarkable progress has been displayed by Messrs. Armstrong, Whitworth & Co., of Newcastle-on-Tyne, and Messrs. Vickers Sons & Maxim, of Barrow-in-Furness, the famous British armament manufacturers, who are each building a first-class battleship for the Chilean navy. On February 26 last, as both the new ships were to be as nearly alike as possible and brought up to date, Sir Edward Reed, the English M. P., who is naval architect and engineer of the Chilean government, brought the two firms into close communication in respect of everything of first-class importance in these two battleships, including the design of the two ships and of their machinery, armor, guns, etc. The result of the co-operative action of the builders in this instance is that already the Armstrong Company have worked 3,000 tons of materials, and the Vickers Company approximately the same quantity into the hulls of their respective ships, and have made corresponding progress with the armor, guns, etc. The work of construction was hurried forward by the recent threatenings of a rupture between Chile and Argentina, and the two firms contracted to build and arm the ships ready for sea within eighteen months from the date of signing the order; but the new treaty between the two countries has retarded building to a certain extent, though the two firms, in view of the progress that has been made, are yet hopeful of completing the work within the specified time. If the work is fulfilled within the eighteen months, it will constitute a record for speed in the building of a first-class modern battleship.

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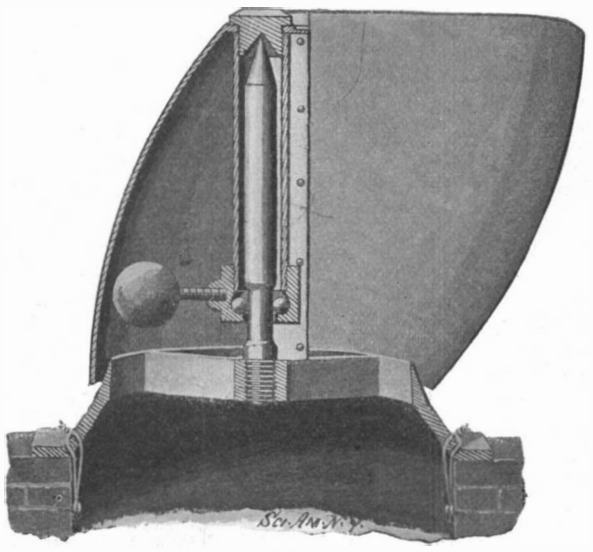
REVOLVING CHIMNEY CAP.

In order to insure at all times a perfect draft in the chimney pot the chimney cap here illustrated has been invented. The device forms a shield for the chimney top, which rotates with the wind to such position as to prevent the wind from blowing down the chimney. By its use the necessity for high smokestacks is avoided. Mrs. Anna E. Cook and Mr. Frederick J. Cook, of Lawrenceburg, Ind., are the inventors of this device.

A head piece is employed which may be secured by any suitable means to the top of the chimney or smoke-

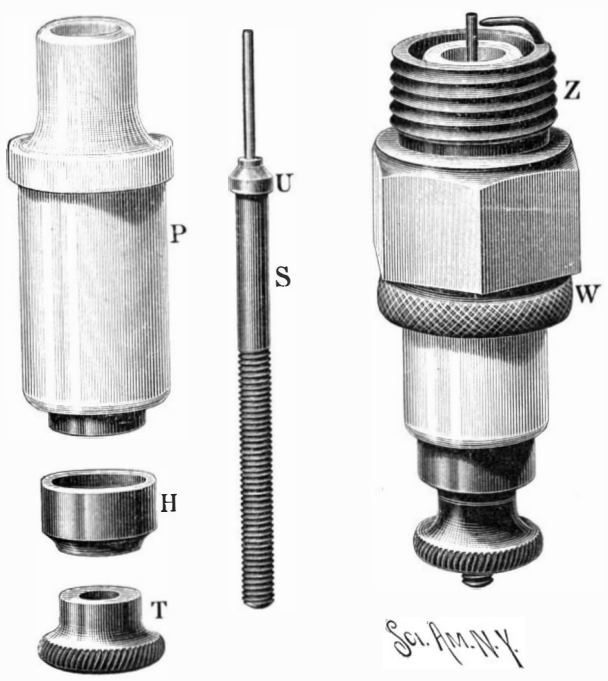


REVOLVING CHIMNEY CAP.

stack. The head piece comprises a peripheral plate and a central hub supported by radial arms. Threaded into the hub is the lower end of a vertical stud or rod on which the chimney cap proper is mounted to rotate. The upper end of this rod is conical and fits into the conical recess of a cap screw. A sleeve piece is threaded at its upper end over the cap screw, and is provided at its lower end with a bearing hub in which are placed a series of balls that bear against the rod. The chimney cap proper is made in two sections. The section shown on the left is of cast metal and is held in place between the head of the cap screw and the sleeve piece. The other section is much lighter, being formed of sheet metal bent to shape and riveted to the cast metal section. Projecting from the ball bearing cup is a stud on which a weight is threaded. The weight may be adjusted along the stud to balance the chimney cap properly. In operation the wind striking the chimney cap will rotate it to the position offering the least resistance. This position will be reached when the upwardly sloping cast metal section is presented to the wind. In this position it will be seen that the products of combustion passing up the chimney are directed at an angle with the wind. A good draft is thus maintained, and the evil effects of wind blowing down the chimney are avoided.

A NEW SOOT-PROOF SPARK PLUG FOR GASOLINE MOTORS.

Our illustration shows the parts and ensemble of a recently patented spark plug, the invention of Mr.



A NEW SOOT-PROOF SPARK PLUG FOR GASOLINE MOTORS.

C. A. Mezger of 12 Clinton Street, Brooklyn, New York city. The plug has two wide and deep air gaps between the center wire and the outer shell. These parts are well insulated from each other by a single, heavy porcelain, which fits loosely in the shell *Z* and rests upon a shoulder in the latter. A brass packing ring, *W*, that screws into shell *Z* presses the procelain *P* tightly upon an asbestos washer that rests upon the shoulder in *Z* and makes a tight joint between it and the porcelain, thus preventing any gas leakage. The spindle *S* is also packed with asbestos where its shoulder *U* is pressed upon the edge of the hole in *P* through which *S* passes. The cap *H* is screwed on the threaded part of *S* till it presses tightly against *P* and thus clamps the spindle *S* tightly in place. The porcelain is tipped with a brass cap over which *H* fits. A thumb-screw *T* is used for securing the wire from the spark coil.

The construction of this plug is of the strongest. The porcelain being in the form of a single large tube, of which the inner end, exposed to the hot gases, forms a tapering shell, it would seem as if the chances of breakage should be very slight. Furthermore, the center spindle and wire are made of one piece of nickel steel, the spindle being turned down to the size of a wire at the end that projects into the cylinder. A nickel-steel wire also is fastened into the shell, the inventor having found this to have more lasting qualities than the platinum wire that is generally used.

The principle followed by the inventor in designing this new plug is, that by arranging for a sufficiently great surface of insulating material between the outer shell and the center spindle, the resistance of any layer of carbon that may happen to form on the porcelain will be greater than that of the spark gap in the compressed gas. Consequently, following the path of least resistance, the spark will always jump. Proof of this is to be had by the fact that if the porcelain shell is coated with carbon in a gas-jet, and the plug then inserted in the motor, the latter can be started with the same ease as if the plug were perfectly clean. The plug appears to be one of the best solutions of the high-tension ignition problem that has as yet appeared upon the market.

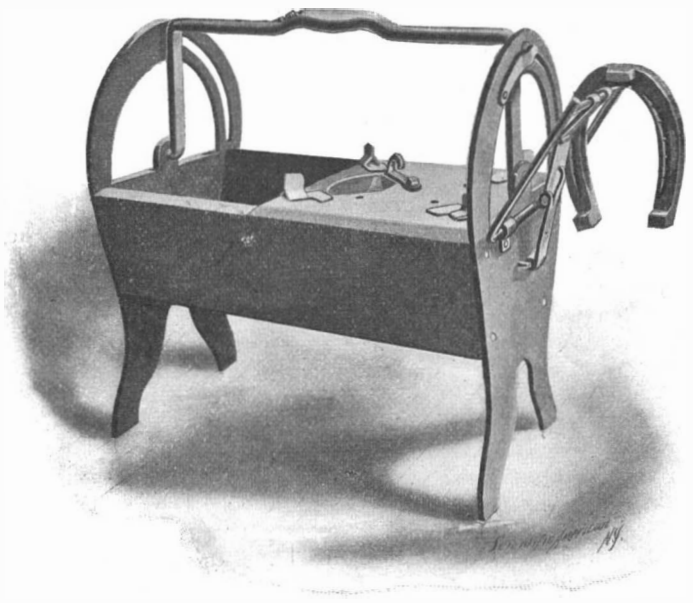
AN AUTOMOBILE AMBULANCE.

The automobile has been applied to a wide variety of uses since it became popular in the United States, but it is believed that the city of Cleveland has the only one which is used for an animal ambulance. Dr. W. H. Staniforth, of that city, has an infirmary for dogs and cats and makes a specialty of their treatment. For some time past he has used an auto especially designed for taking patients to and from his hospital. The rear portion is similar in design to the ordinary runabout, but the front portion has been enlarged to sustain a platform containing a wooden case which is divided into upper and lower sections, the upper portion being used for cats, as its name implies, and the lower portion for dogs. The sides of the case have slits protected by wire to admit the air, while each contains a dish of water. The portion for the dogs is divided also into two sections, so that three or four canine patients can be taken at a time. The accompanying photograph shows the doctor making his rounds in the automobile, with his two pet bulldogs, who usually accompany him.

As the result of an extensive series of investigations into the subject of streaming protoplasm, A. J. Ewart comes to the following conclusions: The viscosity of the protoplasm is the most important physical factor which determines the velocity of the streaming motion. Change of temperature causes a reaction mainly in so far as it alters the viscosity; a rise in temperature decreases the viscosity and increases the velocity. Light has no direct action, and gravity only affects the movement to a very slight degree even in large cells. Acids, alkalies, and metallic poisons all retard the streaming; but alkaloids, although they are strong muscle or nerve poisons, have but slight action. In agreement with other experimenters, alcohols and anæsthetics, when present in small quantities, are found to accelerate the motion, but in larger quantity produce an inhibiting effect. With regard to the energy which gives rise to movement, Ewart is of the opinion that the only kind of energy which appears to be capable of being generated is due to surface tension. This is produced in the moving layers by electrical currents, and their source is to be looked for in chemical changes in the substance of the protoplasm.—Proc. Roy. Soc.

HORSESHOER'S BOX.

Of particular interest to blacksmiths is a recent invention patented by Mr. John B. Fladby, of Rutland, North Dakota. The invention relates to improvements in boxes for holding horseshoers' tools, nails, and shoes. One of the principal features of the box is the provision of a tray divided into compartments for different sizes of nails, and so arranged that only one compartment will be uncovered at any one time, thus preventing



HORSESHOER'S BOX.

mixing of nails on the floor, should the box be tipped over. Another feature is the provision of a convenient folding rack for holding horseshoes.

The box, as illustrated, is divided at the center by a transverse partition, at one side of which is an open receptacle for rasps, hammers and other tools. At the other side of the partition is the circular tray divided into compartments for containing the different sizes of nails. The tray is mounted on a center post having a step bearing in the bottom wall of the box and extending at its upper end through the cover piece or lid. The lid is provided with an opening at one side through which access may be had to the compartment directly below. A lever which is secured to the projecting end of the tray post may be operated to bring any of the compartments of the tray under this opening. If the operator should desire some nails of a certain size, the lever is turned until it points to the corresponding indicator-plate; this will bring the proper compartment under the opening. A simple catch is provided for holding the tray against turning except when it is desired to use a new compartment. A convenient handle is provided for carrying the box about and this, when not in use, may be turned down out of the way. At one end of the box is the rack for holding horseshoes. This rack when in its upper position is supported by a series of links which have hinged connection with each other. The arrangement is such that when the horseshoe rack is raised to this position a finger on the lowest link snaps into an opening in the middle link and locks the parts

AN AUTOMOBILE AMBULANCE.

against downward motion. When not in use the rack must first be raised slightly and the joint between the lower links forced outward when the rack may be folded down neatly against the side of the box.

The invention is noteworthy for the simplicity of its design and of its construction, and for the efficiency of its operation.

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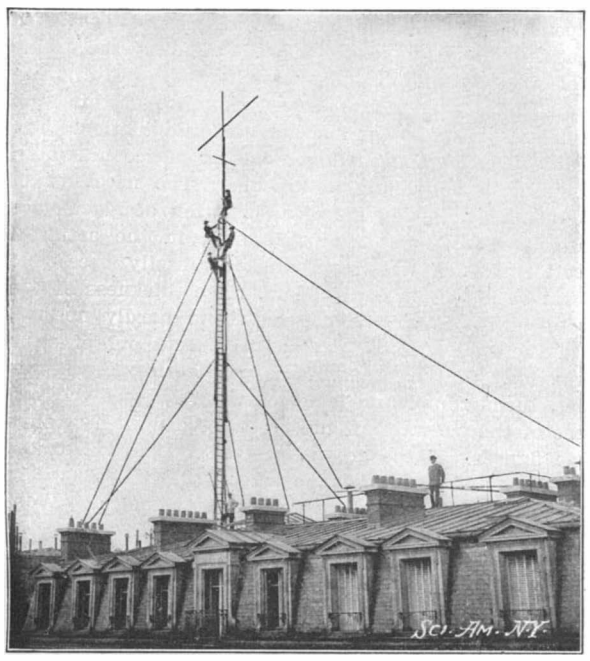
POPP-BRANLY AERIAL TELEGRAPHY SYSTEMS.

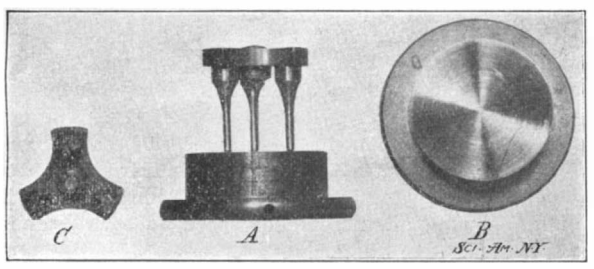
BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An aerial telegraphy project of unusual interest is now being organized in Paris. It is the intention to establish a subscriber system which will cover the whole city, and the subscribers will be kept posted as



Mounting the Masts.

to all the important news of the day. A company has been formed for the purpose, which company is headed by Victor Popp, a prominent engineer and director of compressed air and electric lighting systems in Paris; with him is associated Dr. Edouard Branly whose work in aerial telegraphy is too well known to be dwelt upon. This company has already installed a station at its headquarters, Place de la Madeleine, and two others at the newspaper offices of the Figaro and Journal, besides a third at the Agence Havas,



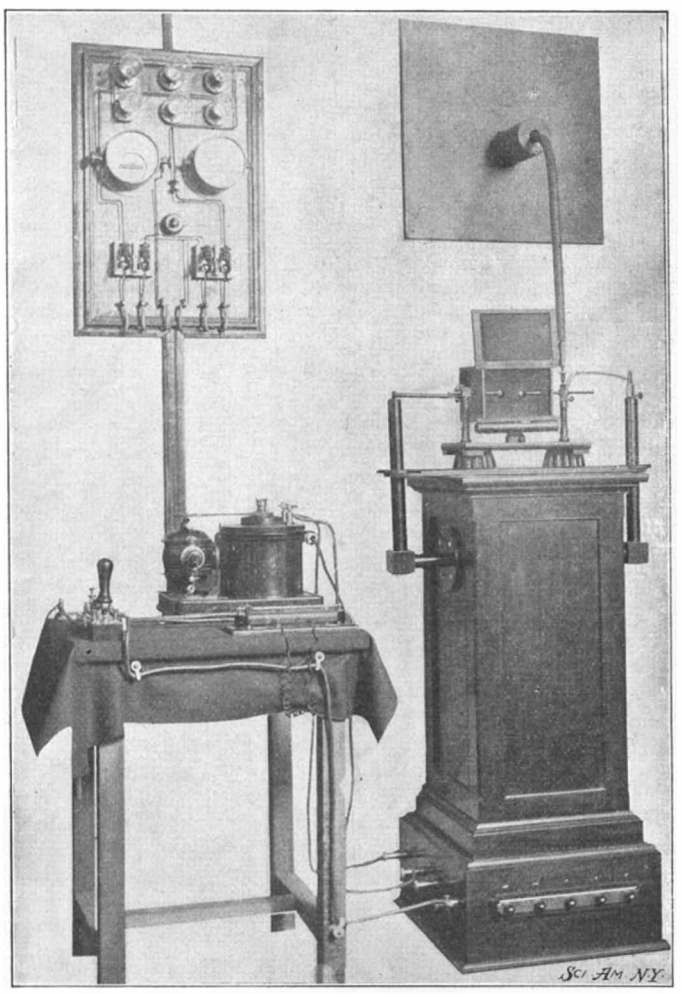
Details of the New Branly Coherer.

A, tripod on base; B, base; C, tripod, end view.

near the Bourse. For some months past messages have been regularly sent between these posts and there seems to be no question as to the practical operation of the system. Dr. Branly's newly improved instruments are used and the masts are mounted on the roofs of the buildings.

The execution of the subscriber system will no doubt be carried out shortly. For this purpose a main transmitting station will be established in a central locality, perhaps near the Bourse. This post will have ample telegraph and telephone facilities for receiving the news of all the important events of the day. As the news is received, the central post will transmit it in turn by aerial telegraphy to a series of receiving stations distributed throughout the city and suburbs. From these, cyclist messengers will carry the news to the subscribers' houses say every half hour. Thus the subscribers will be kept posted on all the leading events both of home and foreign news, stock quotations, markets, etc. The relatively small cost will place the system within the means of many persons. The system will be especially valuable for hotels, clubs, cafés, etc., which are to have bulletin boards for posting the news. The utility of such a system will be at once apparent, for it will greatly further the business interests of the city.

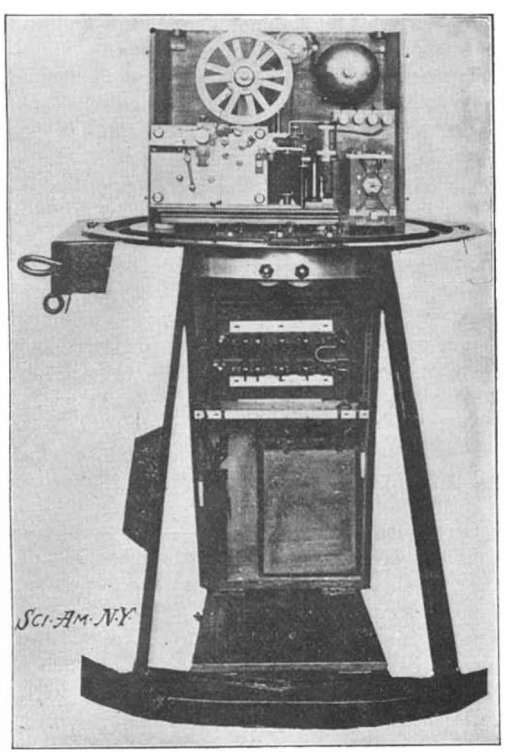
Among the instruments used, the new coherer and transmitting device has attracted considerable attention. M. Branly has lately discovered a new form of coherer which has several advantages over the ordinary type which uses a tube with metal filings. It is of a more solid construction and at the same time more sensitive; the most valuable improvement is the suppression of the tapper, which makes the whole apparatus considerably simpler. The principle of the new coherer is that of a contact between a polished and an oxidized metal surface, and as now constructed it has the form of a small tripod about an inch high resting upon a metal plate, as will be noticed in the engraving. The cohering action takes place between the ends of the three rods and the lower plate. The rods are of steel about ⅛ inch in diameter at the lower part and are united above by a circular metal plate. To the latter is connected one terminal of the circuit. The ends of the rods are first well cleaned and polished and are then given a slight coating of oxide by heating in a closed receptacle in a gas-furnace. It is necessary that the coating should be of a determined thickness and this is obtained by regulating the temperature of the furnace. The lower plate upon which these oxidized points rest is of steel and has a highly polished surface. The rods of the tripod are in parallel in the circuit. The engraving shows the tripod and lower disk; to the right is seen the polished surface of the latter and to the left the ends of the rods. The degree of oxidation of the points is an essential feature and upon it depends the sensitiveness of the coherer. This type has been found to be more sensitive than the tube with metal filings and experiments showed that it worked with a small spark over distances at which the filing coherer failed to respond regularly. Owing to its greater sensitiveness, voltages of ½ to 1 volt are used. After the decohering action takes place by a spark, a slight shock brings back the conductivity even when working on a closed circuit through a resistance. Under the usual conditions of open circuit a very slight shock is found to answer. The latter feature enabled the inventor to place the tripod directly upon the Morse receiving instrument and the shock is given by the striking action of the armature. This is a considerable improvement, as it simplifies the apparatus of the receiving station. The receiver may be also made to work more rapidly. One of the pictures shows the Morse receiver and tripod coherer to the left; the diagram shows the connections. A battery cell of ½ volt has one pole joined to the upper tapping screw of the receiver, *A*, and the current passes down through the screw to a platinum disk *P* fixed to the movable arm of the instrument. The disk is insulated and is connected by a flexible wire to a sensitive Claude relay, *R*, then to a variable resistance *r* and to the lower steel disk *D*. The tripod is connected to the battery, completing the circuit. The relay closes the second circuit, including two to four Leclanche cells and the receiver magnets. When a spark is sent from the transmitting station, the coherer acts and closes the relay circuit. When the relay acts it throws in the receiver magnet and the armature arm is drawn down. The platinum plate being separated from the screw, the relay circuit is opened and consequently the receiver circuit. Meanwhile the arm continues downward by its inertia and strikes the lower screw *B*. This screw is fixed in the platform which carries the coherer, as will be observed. The shock of the arm against the screw is sufficient to act upon the coherer and open the circuit. The spring then brings up the arm against the upper screw and the contact is established as before. It will be seen that by utilizing the action of the receiver to give the shock to the coherer, the independent tapping device is eliminated and the whole reduced to a simple form. Owing to the slight shock which is required for the coherer the play of the tapping arm



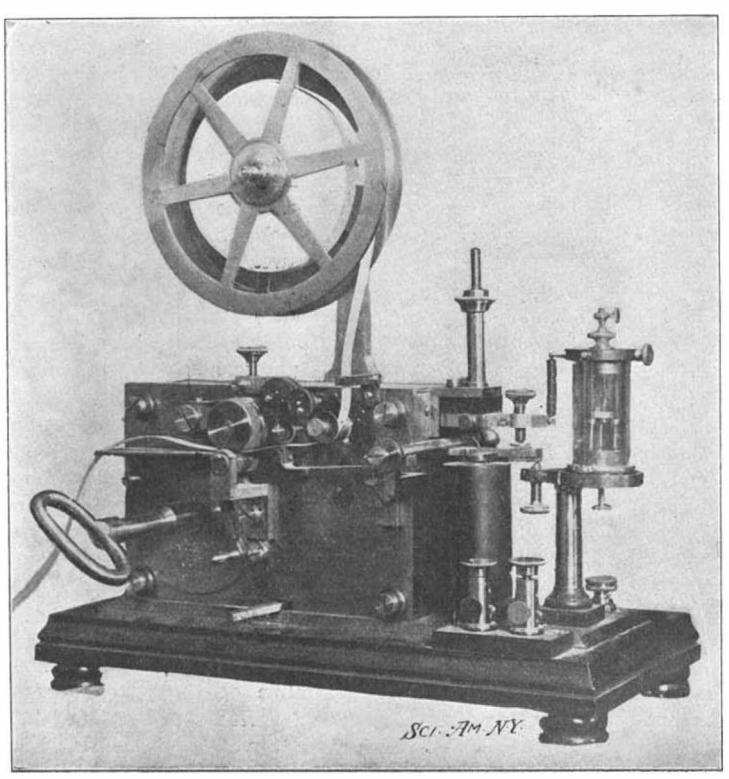
A Transmitting-Post.

may be reduced, resulting in an increased speed of reception. The tripod coherer is inclosed in a glass protecting cylinder and the whole is very compact, measuring but 2 inches high and 1½ inches in diameter. When not in use the tripod is lifted off the lower plate by turning an upper screw around which is wrapped a flexible wire connected to the tripod and answering at the same time for the current. The transmitting station, which has apparatus of the usual type, is shown in an engraving. On the left is the contact key and the motor operated interrupter for the induction coil. Above is the switchboard with instruments. The induction coil is contained in the right hand case, with a variable condenser below and the discharger mounted on top; the upper cable leads out to the mast.

Besides the Paris system the company has a number of other projects under way. It is expected to establish a system of maritime posts all around the coast of France in order to communicate with vessels. At present two such posts are being erected on the north coast, one at Cape Gris Nez and a second at Cap de la Hague, and these are to be finished by the end of November.



Marine Receiver Mounted on Gimbals—Battery and Resistance-Box Below.



Morse Receiver with the New Branly Coherer.

POPP-BRANLY AERIAL TELEGRAPHY SYSTEMS.

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Others will follow and finally it is expected to cover the whole north and west coasts, as well as those of the Mediterranean. Later on the system will be extended to the French possessions in Africa, along the north coast from Algiers to Tunis and also on the west coast. It is proposed also to connect Madagascar with the mainland and from thence by telegraph with the north.

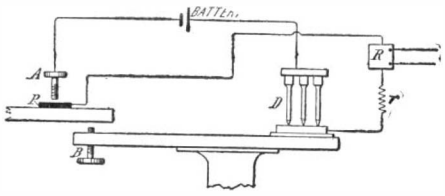

DIAGRAM OF THE RECEIVING SYSTEM.

M. Popp and Lieut. Monteil have a project for connecting Tunis with Lake Tchad across the Sahara by a succession of aerial telegraphy stations. The Lake Tchad station will connect to the projected telegraph lines extending to the existing Niger and the Congo systems.

Exhibition of Recent Scientific Inventions at the Royal Society, London.

Some interesting exhibits relating to recent inventions and discoveries in the various ramifications of scientific and electrical research have been on view in London at the rooms of the Royal Society of Great Britain.

An apparatus for the administration of chloroform, combined with air for the formation of an anæsthetic, the invention of Mr. A. Vernon Harcourt, was exhibited, the salient characteristic of which is that the chloroform may be administered without any apprehension of danger to the patient. In this contrivance there are two vessels, in one of which chloroform mixed with alcohol is placed, and in the other pure water, over the surface of which liquid air is drawn. When passing over the first vessel the air absorbs approximately 2 per cent of its volume of the chloroform and spirit, the latter of which mixture is absorbed by the water when passing over the second vessel, leaving only pure chloroform. The air with chloroform is then drawn through a third vessel, filled with a double-way cock, by which it is further diluted with any quantity of air to any desired extent. For the administration of the chloroform to the patient a special contrivance is placed over the mouth, which is fitted with two valves. One valve is connected to the vessel containing the chloroform and the patient when inhaling draws the chloroform from the vessel, and when exhaling, emits it through the second valve into the atmosphere.

The Hampson hydrogen liquefying apparatus was also shown. Hydrogen when compressed at ordinary temperature and then permitted to expand becomes warmer. This is a peculiar distinguishing feature of this gas. But if the hydrogen is compressed at a temperature below the normal and is then permitted to expand, instead of becoming warmer, it grows colder. In the Hampson apparatus the hydrogen in the gaseous state is passed under a pressure equivalent to 150 atmospheres through coils cooled by solid carbonic acid, liquid air at a temperature of 185 deg. Cent., and by liquid air boiling under reduced pressure at 200 deg. Cent., into the interior of the apparatus. The passage of the hydrogen through these coils considerably cools it, and in this state it enters a regenerating coil, and by expanding through a valve at the bottom of the coil becomes partially liquefied. The liquefied gas is caught into a vacuum vessel placed under the liquefying apparatus. That portion of the hydrogen which is not liquefied returns through the regenerating coil to the compressor, cooling the other gas as it passes. Liquefaction of the hydrogen is comparatively rapid—about a pint being obtained in the course of half an hour. Dr. Travers, who exhibited the Hampson apparatus, has determined the melting point of hydrogen to be 14.1 deg. absolute.

Another ingenious contrivance was Prof. H. L. Callendar's apparatus for ascertaining the mechanical equivalent of heat, an invaluable device for engineers. It consists of a brass cylinder 6 inches in diameter by 2 inches in length. This vessel is half filled with water and is kept revolving by an electric motor. A brake strap composed half of silk and half of leather with a floating weight at each end is placed around the periphery. The means of keeping the weights afloat is very ingenious. When the coefficient of friction increases, the strap slips round the cylinder, bringing the silk portion into contact with the latter, and the immediate result is a diminution of friction. On the other hand, if the coefficient of the friction decreases, the strap slips round the cylinder in the reverse direction until the leather is brought into contact with the cylinder, when the friction is increased. By this alternate increase and decrease of the length of the respective materials upon the cylinder, the position of equilibrium can be soon ascertained, and the exact number of foot pounds exerted may be determined by calculating the weights and rotating velocity. The temperature is recorded by means of a platinum thermometer.

Some experiments were also carried out to illustrate certain phenomena. One of the most interesting was an artificial production upon a small scale of the aurora borealis by Prof. W. Ramsay. To produce this remarkable phenomenon, a powerful electro-magnet is placed in a vertical position, and pole pieces extend from both the upper and lower ends of the magnet in a horizontal direction. Between the pole pieces is placed an exhausted glass globe containing an annular ring in its upper part. A powerful alternating current is discharged through the ring in the glass sphere, producing an annular glow discharge. When a current is directed through the coils of the electro-magnet the annular glow discharge in the globe is deflected downward in the form of streamers, very similar to those of the aurora borealis. As is well known, investigations of the spectrum of the aurora borealis have conclusively proved the presence of krypton in the phenomenon, and Prof. Ramsay practically illustrated this discovery by filling the globe with highly rarefied air, which immediately resulted in the production of the krypton in the discharge.

Prof. Johnstone Stoney, F. R. S., comprehensively illustrated the interference between portions of light from independent sources. A broad sodium flame was reflected by lenses upon a diffraction grating with 26,000 reflecting strips. A slit was then interposed, but parts of the light which fell upon widely separated strips of the grating, emanated from different parts of the flame, and in phases and polarization conditions, were not related to one another. Yet the portions of light reflected from these strips interfered with one another, resulting in the same distribution of light, and the spectra produced was in every way as pure as if the reflection of the flame had fallen upon the slit instead of upon the grating. Also, no matter to what width the slit was adjusted, the definition of the *D* lines of the spectrum of the second order was remarkably clear. In another experiment Prof. Johnstone Stoney threw the image of a flat flame upon a microscopic diatom with hexagonal markings, and a large number of circular spectra were observed gathered around a common center.

A very interesting experiment was also shown of a paradoxical consequence of the wave theory of light. It is a well-known fact that if a ray of light falls upon a right-angled prism of the conventional type, the light is totally reflected at the internal surface of the hypothenuse and emerges at the other rectangular face. But at the same time the hypothenuse surface must be perfectly clear, otherwise the light will not penetrate it. This latter condition was proved by an interesting experiment carried out by Messrs. Edser and Senior. They used a prism, the hypothenuse surface of which was marked with a photographic diffraction grating of 3000 lines to the inch, the rules being parallel to the axis of the prism. When this lined hypothenuse face was exposed to a ray of light, the latter was not reflected at the face, but a considerable portion passed out through the grating resulting in brilliant diffraction spectra.

The Structure of Glacier Ice.

Mr. J. Y. Buchanan, the well-known scientist who has made extended study of the structure of glacier ice, principally from the Aletsch Glacier, has found that the weight of the individual grains of ice varies considerably. The fragments of this glacier which float as icebergs in the Mergelin Sea are exposed to the powerful weathering of the summer sun, and are comparatively easily dissected into their constituent grains. A number of blocks were so dissected in order to ascertain the weight and size of the largest grains, when the following weights of single grains were determined: 700, 590, 450, 270, 255, 170, 150 and 100 grammes. The blocks of ice contained grains of all sizes which fitted each other so exactly that in the fresh unweathered block the whole volume was filled with ice.

The sun's rays on glacier ice accomplishes a dual operation—it disarticulates the ice into its constituent grains, and it splits the individual grain into laminæ perpendicular to the principal axis of the crystal, and bounded by the planes of fusion as discovered and described by Tyndall. These planes are the distinguishing characteristic of the individual ice grain. Under the influence of radiant heat an ice crystal begins to melt at the surfaces which separate these laminæ, and the process of disintegration and decay is directed by their plane. On the other hand, an ice crystal floating in water and losing heat generates ice laminæ, which are directed by the same planes and which form the continuation of the corresponding laminæ of the parent crystal. This was well observed during the Mergelin Sea observations. Every night a thin skin of ice was formed at the shallow end of the lake where the ice blocks collected. As the grains in a block of glacier ice are distributed quite irregularly, the water line of a floating block necessarily cuts a great number of grains, all of which are oriented differently. The ice crystals which were formed during the night along this line were oriented each one by the grain with which it was in contact, and from which it appeared to spring in continuation of its crystalline laminæ.

The disarticulating and analyzing action of sun's rays is not accomplished without the selection and expenditure of energy. Accordingly it is observed that one grain protects another. It is only the grains that are exposed to the sky, and above water, that are so analyzed, and prolonged exposure of this kind reduces a grain to the last stage of dilapidation. The grains beneath the surface, whether of ice or water, are almost completely unattacked. The necessity of direct sky light for the disarticulation of glacier ice into its constituent grains is seen in the artificial grottoes which are maintained at easily accessible parts of most popular glaciers. The thickness of the softened ice is so trifling that it is hardly noticed, and the whole grotto appears to be cut out of clear blue ice. If the observer on penetrating for a few feet, turns round and looks outward he sees the surface of the ice walls of the grotto etched with strange line figures. These are most strongly marked at the opening, and they cease exactly at the spot where the last ray of direct sky light strikes the ice. Were it not for the fact that a glacier is made up of distinct grains of ice, and that this substance has the property of melting and freezing at different temperatures, according to the composition of the water with which it comes in contact and to the pressure to which it is subjected, there is little doubt that a glacier would be as motionless as any other mass of crystalline rock.

Trial of the "Adder" and "Moccasin."

The latest Holland submarine boat "Adder" had her trial trip on the afternoon of November 11. After some preliminary work she dived, and while submerged made eight round trips over a quarter of a mile course. She was made to perform various evolutions, such as rising to the surface, dropping deeper, diverging in both directions and turning in a short space. The speed test showed that when submerged she could make 7.23 miles an hour, which is nearly one-fourth of a knot over the contract requirements. On November 12 the "Adder," in conjunction with the "Moccasin," was submitted to another test. The required conditions were four runs awash under one, two, three, and four cylinders respectively. The first half-mile was made in 5 minutes 45 seconds, the second in 3 minutes 50 seconds, the third in 3 minutes 30 seconds, and the fourth in 2 minutes 55 seconds, showing an increase of speed as each cylinder was added.

The second trial was with the boat in light condition. Six runs were made over the course, half with and half against the wind. The times taken were as follows: First, 4 minutes 19 seconds; second, 4 minutes; third, 3 minutes 36 seconds; fourth, 3 minutes; fifth, 3 minutes 15 seconds; sixth, 2 minutes 53 seconds. At noon the observers on shore reported that the "Adder" had exceeded her contract speed easily.

In the afternoon the "Moccasin's" light trial took place. It consisted of three half-mile runs against the wind and three with it. While the "Moccasin" did not make as fast time in some of her runs as the "Adder," she was, on the whole, considered steadier. Her times were: First, 8 minutes 40 seconds; second, 5 minutes 5 seconds; third, 4 minutes; fourth, 3 minutes 5 seconds; fifth, 3 minutes 27 seconds; sixth, 3 minutes 35 seconds.

Both boats exceeded their contract speed of 7 knots under awash and 8 knots under light conditions by more than half a knot.

The Trial of the Lebaudy Airship.

The airship built for Pierre and Paul Lebaudy was tried near Nantes on November 13. Several free ascents and descents were made. The flying machine, after making revolutions in every direction over fields and woods bordering the Seine between La Roche, Guyon and the town of Bonnières, returned each time to its point of departure. The Lebaudy ship is similar in appearance but twice the size of the airships of Santos-Dumont. The machine was first tried on November 8, when it was successfully operated for half an hour.

At the recent opening of the Copenhagen Exhibition, a letter was made public from Thomas A. Edison on the future of electric traction. Mr. Edison asked as to his opinions concerning electric traction and aerial navigation replied: "I believe that within thirty years nearly all railways will discard steam locomotives and adopt electric motors, and that the electric automobile will displace the horse almost entirely. In the present state of science, there are no known facts by which one could predict any commercial future for aerial navigation."

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Correspondence.

Col. J. J. Astor's Turbine Patents.

To the Editor of the SCIENTIFIC AMERICAN:

In my typewritten letter to you last week, I said I *present* all my turbine patents to the public. Through a typographical error, you printed this "dedicate" which might not mean free gift, which is the idea I wish to convey to all who may be working on improvements in turbines.

Please make this correction as early as possible.

New York, November 8, 1902. J. J. ASTOR.

Leakage from Gas Mains.

To the Editor of the SCIENTIFIC AMERICAN:

I note with interest your article on "Street Ventilation," contained in your issue of November 1, in which, among other causes of ground contamination, you refer particularly to leaking gas mains, the following being an extract from your article:

"According to the statement of one sanitary expert, it is generally acknowledged by the gas companies of our city that fully one-third of the whole quantity of gas manufactured by them leaks away, before delivery through the house meters occurs. They recognize that it is far cheaper to manufacture this large excess of gas and allow it thus unheeded to contaminate the lower atmosphere of streets and buildings than to attempt to make tight mains or house connections."

For the information of your readers generally, and in justice to the gas fraternity, I desire to state that you have been very much misinformed, and that the impression given in your article on this particular point is a most erroneous one, as the amount of gas lost by leakage bears no such large percentage as that stated above.

It is true that there is always more or less leakage, but it is safe to say that for many years past the percentage of gas lost by what is ordinarily known as "leakage," that is to say, the difference in the amount of gas actually manufactured and that accounted for by consumers' meters, is not more than ten per cent, which includes not only the gas actually escaping but condensation and the reduction in volume owing to the difference in temperature between the station meter of the gas company and the meters used by the consumers.

In all probability the amount of gas actually escaping and finding its way into the earth is usually not more than from eight to ten per cent, and this on the old systems of cast-iron gas mains generally in use. On new and up-to-date street main systems, in connection with which especial attention is given to making particularly tight joints, the gas leakage will amount to much less than the above, and in some cases it is as low as from three to five per cent.

It is undeniably true that there are some old and improperly constructed gas-distributing systems in small towns on which the leakage account runs very high, and may even reach the amount stated in your article, but these cases are very rare; and if the plants in connection with which they are used have any value at all, they eventually find their way into the hands of gas men of ability, whose first work is to overhaul the street main systems, thereby reducing the leakage to a normal basis, which is one of the principal factors in the conversion of such a property from a losing to a paying basis. L. P. LOWE.

San Francisco, Cal., November 5, 1902.

The Current Supplement.

SUPPLEMENT No. 1403 contains the usual number of interesting articles upon metallurgical, physical, electrical, astronomical, and other subjects. The front page is taken up with illustrations of the new El Paso, Texas, Smelting Works, which is the most modern plant of its kind in the country, and is noteworthy from the fact that all its power is produced from Beaumont oil. The plant is fully described. Mr. Henry G. Kittredge's article on the Utilization of Waste and By-Products in Manufacturing is continued, the subjects of Paper Manufacture and Slaughterhouse Products being discussed. Among articles under the head of Physics are descriptions of a new Pressure Indicator for Explosions, the Recording Weather Vane on the Eiffel Tower, the Biography of a Snowflake, and the Atomic Theory Without Hypothesis. The use of electricity in mining plants is shown in an article on Electrical Power on the Comstock Lode, while some suggestions from a German contemporary about a new method of starting induction motors will be found most interesting by many electricians. Many Contemporary Electrical Science Notes will also be found in this issue. A technical description of Prof. Atwater's Respiration Calorimeter tells of the novel mechanism in this apparatus, while Recent Progress in Astronomy, and the Dead Sea as it is To-day describe some of the present wonders of the heavens and the earth. In archæology, a well illustrated description, with plans, of the House of Minos, in Crete, furnishes some very interesting reading. A full page of Trade Suggestions and Consular Reports will be found near the back of the paper.

Engineering Notes.

Of the engines running on the Russian railways, 4,766, or 39 per cent, were built abroad, and 7,421, or 61 per cent, in Russian engine yards. The St. Petersburg and Warsaw Railway has the greatest number of passenger engines, namely, 201; then come the South-Western Railways with 172, the Moscow, Yaroslav and Archangel Railway with 124, and the Southeastern Railways with 104 locomotives, while the remaining lines have each less than 100 locomotives at work.

At the present time, in the middle island of New Zealand, there are about 240 dredges, costing from $25,000 to $70,000 each, in course of construction or ordered. Dredges are at work or about to work on the following rivers: Molyneux, Clutha, Kawarau, Manuarhekai, Dart, Shotover, Lindis, Waiau, Mataura, Waipori, Nevis, in Otago and Southland; in the Westland and Nelson on West Coast; on the Totaru, Hokitika, Grey, Ahura, Buller, Inanghua, and Orwell Creek. There are also a great number of gold-bearing flats which are being dredged.

The process of widening London Bridge, the scope of which was fully described in the SCIENTIFIC AMERICAN, is proceeding rapidly. The contractors have raised two sections of the wrought-iron bridge from a large raft in the river into position on iron piers on the west side of the bridge. This bridge and a similar one on the east side will be used by pedestrians while the old bridge is being widened. The sections raised each weighed eighty tons and were raised into position by hydraulic energy, the 160 horse power required to accomplish the operation being assisted by the incoming tide.

While there are probably large undeveloped mineral resources in other provinces of Cuba, mining as an employing industry is practically confined to Santiago. The copper mines once so successfully exploited are being reopened, but do not yet appear in labor statistics. Manganese mines have been developed since the American occupation, about 125 men being regularly employed at 85 cents American money for a ten-hour day. This is surface working, and the mines are some distance from the city of Santiago. The iron mines of this province employ over 4,000 men when sufficient labor can be obtained.

WORK has been commenced upon the elaborate dock extension scheme at Manchester for the development of traffic between that city and foreign countries via the Manchester Ship Canal. The traffic of this waterway has expanded so rapidly during the past few years that the present dock accommodation at the terminal port of Manchester are altogether inadequate to cope with it. The new works will cost some $2,500,000 to complete, and it is anticipated that they will be finished by April, 1905. The land purchased for the necessary extension was the Trafford race course, for which $1,325,000 was paid. The work involves the excavation of a million cubic yards. For the waterway of the new dock alone 850,000 cubic feet of earth will have to be removed. The new dock will be 3,700 feet long and 250 feet wide, and broader at the mouth to permit large steamers to turn around. It will have a depth of 28 feet to accommodate large vessels. The trading capacity of the docks will thus be increased to the extent of about 950,000 tons per year. Between this dock and the next a new transit shed 2,250 feet long and 110 feet wide of four floors will be built.

During the recent trials and experiments with alcohol for motors in Paris, M. Sorel carefully examined the exhaust gases to ascertain if complete combustion were effected with the various alcoholic agents utilized. He has prepared an extensive report upon the subject. From this it appears that he nearly always found acetic acid in the exhaust gases, proving that thorough combustion was not attained. It is also apparent from the various vehicles M. Sorel examined that the capacity of combustion is the least with light high-speed vehicles, but he even found that heavy motors did not obtain the efficiency expected in this direction. To insure perfect combustion M. Sorel has found by experiment that the air supply which has been calculated upon a theoretical basis as sufficient to attain perfect combustion is deficient by 50 per cent. This scientist intends to investigate the subject still more, and to ascertain exactly what air pressure is requisite to insure the most efficient combustion, and the result of these investigations should prove of great value to those who use alcohol-driven motors.

Oil Fuel on Transatlantic Trip.

The American Line steamship "Kensington," which arrived on November 4 from Antwerp, used oil for fuel under one boiler throughout the trip. At the height of the coal strike the "Kensington" had one of her single-ended boilers fitted with oil burners. The other two boilers, which are double-ended, were left as they were. This is the first record of a passenger ship coming across the ocean with oil used even partially as fuel.

Electrical Notes.

Two electric locomotives, ordered by the Baltimore & Ohio Railroad Company from the General Electric Company are said to be the two largest electric locomotives in the world. Each machine will weigh 150 tons, and be capable of drawing 1,500 tons of freight up the heavy grades of the belt line tunnel, which runs nearly two miles under the city. Passenger trains have been drawn through the tunnel by electricity since it was opened in 1895, but the locomotives now in use are not capable of pulling the heavy trains. The new machines will be designed to haul a load equal to twice that drawn by the present steam locomotives.

The first of the new time-saving appliances for transhipping mails and baggage in connection with the cross-Channel services at Dover has been brought into operation. An electric traveling gangway was used between the mail steamers and the shore, with excellent results. The gangway is on the principle of an endless platform. It brought packages of any weight ashore at the rate of one in 15 seconds, when worked only at a moderate speed, and while at a sharp incline caused by the low tide. The saving in the time of transshipment was more than half what was formerly required. A precisely similar arrangement worked from one of the steam winches by a belt has been in use for several years in transferring luggage to and from the London and North-Western Railway Company's steamers at Holyhead and Dublin.

The gas works of Tunis now have an electric plant which presents some new features. It uses retort carbon in a gas generator of the Pierson type which produces a low carbon gas. The plant includes two small boilers of 20 square yards heating surface and three gas generators with their various accessories, including a gasometer of 330 cubic yards capacity. The generator has a double envelope and a horizontal grate surface. The outlet tube for the gas is inclosed in a second tube of larger diameter and the mixture of air and steam is injected through the annular space between the tubes. The gas comes out at a temperature of 450 deg. C. The heat lost by the outgoing gas is partly restored by the above arrangement for heating the air and steam. The latter mixture passes under the grate and traverses the incandescent mass of coke and the gas thus formed passes out into a condenser, then to the scrubbers and finally to the gas tank from which the motors are supplied. The gas engines are of the Crossley type and four of these are used at present, having a capacity of 105 horse power each. To them are connected the dynamos for the lighting circuits. The gas producers of the Tunis plant are fed from retort carbon coming from the gas works adjoining and the product is thus utilized to good advantage. The gas motors are arranged so that they can be fed either by coal gas or by producer gas. To carry this out there are two sets of piping, and a series of valves throw on one or the other gas without having to stop the motors or produce a flickering in the lights.

Faraday and a host of subsequent experimenters have investigated the electrolytic oxidation of sulphur dioxide in aqueous solution, and have found that under normal conditions one-half the oxide undergoes oxidation to sulphuric acid at the anode, the remainder appearing as sulphur or sulphureted hydrogen at the cathode. In 1895, however, Dr. Leonard Wacker succeeded in rendering the oxidation quantitative by the concurrent use or production of carriers of oxygen, such as the persulphates, or even the halogens. Mr. Charles B. Jacobs now finds that the same result may be accomplished by a judicious application of the principle that oxidation is facilitated by a concentrated solution and low current density at the anode. In Jacobs' apparatus the anode is a porous composition through which the gas is injected in a continuous stream into the cell, and the anode area is 33 times that of the cathode. The vessel is provided with horizontal electrodes, and an interposed diaphragm. The porous anode constitutes a partition near the base of the cell, and into the lower compartment so formed sulphur dioxide is injected through the pipe, passing through the previous anode and undergoing oxidation therein. An outlet is provided for withdrawal of the sulphuric acid when the hydrometer shall indicate that the desired density has been reached. A refrigerating jacket is provided in order that advantage may be taken of the increased solubility of sulphur dioxide at 0 deg. C. Jacobs, like Wacker, finds that by continuously injecting sulphur dioxide, the sulphuric acid may be brought to standard concentration. While, as stated, the reaction, chemically considered, is quantitative, all of the sulphur dioxide being converted, the electrolytic efficiency is given as 54 per cent; this result is attained with a potential difference of two volts and a current density of 15-20 amperes per square foot of anode surface. Our information is taken from an article by Mr. Clinton Paul Townsend in the Electrical World.

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THE NEW EAST RIVER BRIDGE FIRE.

The recent fire on the new East River Bridge was a most unusual, and certainly very spectacular, disaster, which would never have happened had the company which has the contract for the construction of the cables showed a reasonable amount of dispatch in carrying on the work. To understand the nature of the accident, it may be as well to explain to what point the work of erecting the East River Bridge had progressed. As is well known to the readers of the SCIENTIFIC AMERICAN, the towers have been erected, the main cables have been swung, the approach to the bridge on the Brooklyn side is practically completed, and that on the Manhattan side about half completed. For the accommodation of the workmen in stringing the cables, temporary foot-bridges were strung across over the towers from anchorage to anchorage. All the wires of the four great cables, each 18½ inches in diameter, were strung early last summer and since that time the bridge gangs of the company who are building the cables have been engaged wrapping the cables with a protective covering designed to prevent oxidation; and in covering the wrapped cables with the sheet-steel plates, which are intended to form the outermost covering and shed the water freely in rainy weather. The greater part of this work has been done, and the saddle clamps on which the double suspenders at each panel point of the bridge are supported have, most of them, been put in place and the suspender cables slung over them. The foot-bridges are carried upon four wire cables 2¼ inches in diameter, each of which extends in one length over the towers from anchorage to anchorage.

At the top of each tower, 335 feet above the water, a broad timber platform has been erected, which serves both as a working platform for the workmen and for the temporary storage of material used in construction. There has also been erected over each tower an extremely heavy framework of 12x12 timbers, which was used in temporarily carrying the strands during the stringing of the cables. On the towers at the time of the accident there was stored a considerable amount of waterproofing material, a composition made of oxidized linseed oil, asphaltum, and varnish gums. The fire broke out about five o'clock in the afternoon, and under the influence of a fresh breeze rapidly gained headway, and enveloped the whole of the platforms and timber structure at the top of the Manhattan tower in flames. After the fire had been in progress for a considerable time, the cables carrying the footbridges became so heated that they parted at the towers, with the result that these cables with their timber platforms fell back toward the Manhattan anchorage and toward the Brooklyn tower, much of the wreckage falling into the river. One of our illustrations shows the mass of cables and timber work as it finally lodged near the Manhattan anchorage, while others show the distorted wreck of the footway as it appeared the morning after the disaster, suspended above the East River.

SUMMIT OF THE MANHATTAN TOWER, SHOWING INJURED PORTION OF ONE OF THE MAIN CABLES.

The fire burned with great fierceness, and the 335-foot tower showed up against the black sky like some gigantic torch, affording a pyrotechnic display of weird and spectacular beauty. The fire department made a determined effort to get their hose to the top of the tower; but the work was rendered very difficult by the great height, and by the fact that masses of burning timber and red-hot bolts were continually falling through the towers. Great fears were expressed lest the heat had risen to a point at which it had wrought permanent injury to the main cables, an event which might have necessitated the taking down of the cables and their rebuilding at a cost of a great sum of money and with the loss of a year or two of valuable time. It was therefore with great relief that, on inspecting the main cables and the saddles, it was found that no material damage had been done to the tower and the saddles, and that only the outer layers of wires in the cables had been injuriously affected by the heat. At first thought it may seem strange that a fire which was sufficient to heat the footbridge cables to the point of rupture should have had no greater effect upon the main cables; but it must be borne in mind that the former were carried upon timber saddles and were consequently exposed to the fiercest heat of the conflagration. Moreover, they were only 2¼ inches in diameter, and their mass was so small, relatively, that it quickly became raised to the temperature of the fire. The main cables, on the other hand, because of their great mass, were able to absorb, transmit, and radiate the heat in such quantities, that only the outer layers of wire were raised to a temperature at which they were annealed and their tensile strength reduced. In absorbing and dissipating the heat, they were assisted by the great mass (30 tons) of the cast-steel saddles in which they rested.

On removing the covering plates and waterproof wrapping, it was found that the outer wires for a distance of from 20 to 30 feet across the saddles were warped. This effect can be seen in one of the accompanying photographs, which was taken at the summit of the Manhattan tower the morning after the fire. The report of Mr. Nichols, the engineer of the bridge, states that the heat on the two southernmost cables melted out the protecting material in the saddles and burned off the slushing material from the cables throughout the length of the saddles to a depth of three to five wires. The process of repairing the damage consists in cutting out for a length of say 25 feet the two to three hundred wires affected, and testing them for tensile strength in the testing machine. The cables will be cut down into in this way until the wires begin to show their original strength. New lengths of wire will then be spliced in, the ends being connected by sleeve nuts and drawn up until the desired tension is reached, the splices being staggered in the cable, so that they will

WRECKAGE OF FOOTBRIDGE AT MANHATTAN ANCHORAGE.

THE WESTERLY HALF OF MAIN SPAN, SHOWING WRECKAGE HELD IN THE SUSPENDER CABLES.

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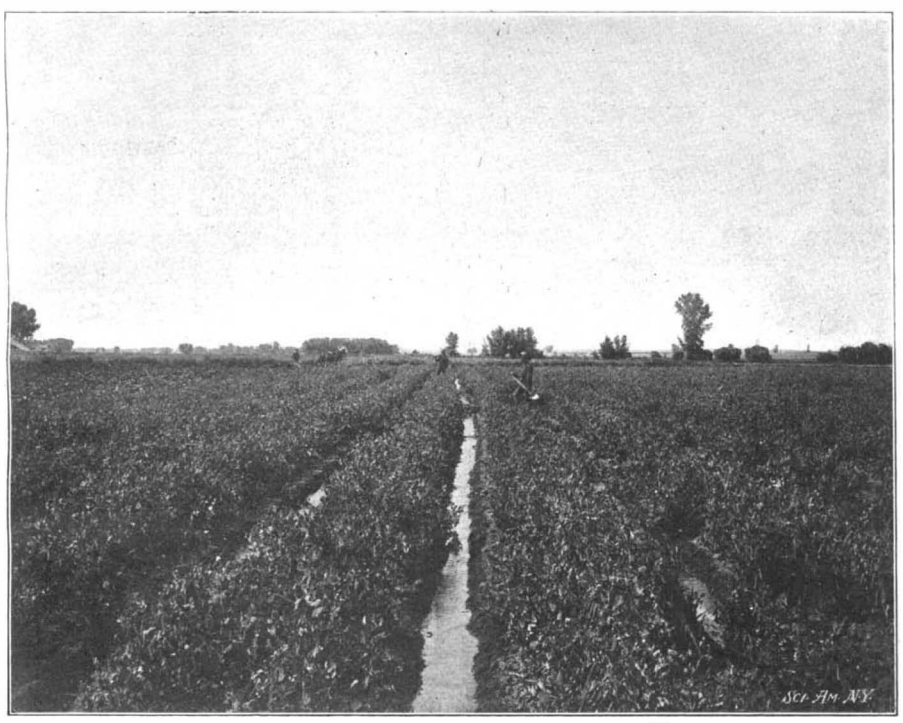
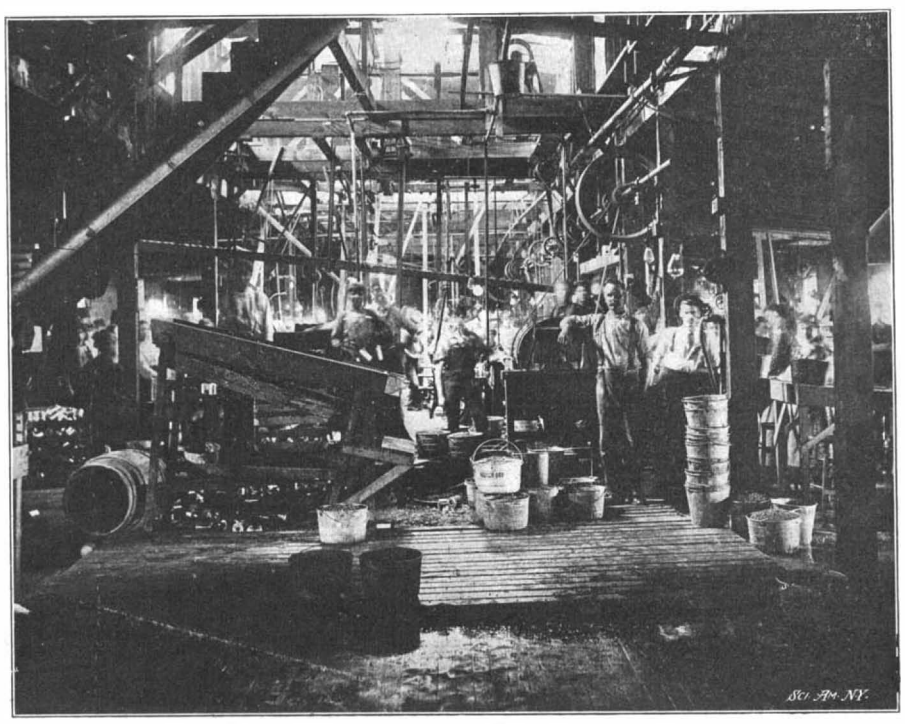
not occur at the same point of section. The certainty that this repair work will fully restore the original strength of the cable is assured by the fact that the cables are only strained at present by their own load, each wire in the cable being under a tension of only 200 pounds, whereas when the suspended structure is built each wire will be under a tension of 1,500 pounds. Moreover, such was the high quality of the steel in the wires, that although the specifications called for 200,000 pounds breaking strength per square inch, the wire when tested by the city's engineers showed a breaking strength of from 220,000 to 223,000

The Cultivation of Asparagus on a Large Scale.



A Portion of a 2,500-Acre Bed of Peas at Longmont, Colo.



Interior of a Typical Western Pea-Canning Factory.

Huge Loads of Peas on the Vine, After Their Arrival at the Thrashing Quarters.

THE RAISING OF PEAS AND ASPARAGUS IN THE WEST.—[See next page.]

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pounds. Hence the wires can suffer a reduction of strength of 10 per cent and yet be within the demands of the specifications.

The city may consider itself fortunate, then, that as far as the ultimate strength of the completed bridge is concerned, it will suffer no permanent harm from the fire. The loss will be one of time, and for this the contractors for the cables will have to make good at a rate of so many thousand dollars a month, as specified in the contract. Fortunately, the footbridges had done their work and were about to be removed. The suspender cables are practically all hung, and as soon as the wreck of the footbridges has been removed, the work of building the floor and roadways of the bridge will proceed.

THE RAISING OF PEAS AND ASPARAGUS IN THE WEST.

To the Easterner, used to his garden bed of peas a few feet square, the idea of growing this product in beds of 2,500 acres and of harvesting and thrashing peas like so much wheat, is a revelation. The West just now holds in store many such agricultural surprises for those from a distance.

In Longmont, Col., the land is prepared for peas just as it is for wheat. The regular wheat drills are used in sowing peas. Two rows of peas are sowed and then a space equal to that occupied by two rows is skipped, thus leaving 21 inches between the double rows for cultivation and irrigation purposes. When the sprouts begin to appear above ground, a harrow is run over them for the purpose of removing the small weeds, and this operation is repeated a number of times during the early part of the season; but a small per cent of the peas are torn out by this process. When the pea-vines become large enough to cultivate, a corn cultivator is used in throwing earth up to them; when five to six inches in height, a furrow for water is made between the rows. The water is brought to the head of the rows in the highest part of the field by a broad ditch. This ditch in turn is a lateral from a main ditch of 30 to 40 feet in width and carrying water from a mountain stream.

The harvesting of peas is begun at the time favorable to the best results, and regardless of the few blossoms and flat-podded peas, all are mowed down by a cutter which runs just beneath the ground. Then the hayracks arrive and great loads of peas on the vines are hauled to the nearby canning factory and are ready for the thrashing operation. The thrashing is done by means of machines constructed especially for this purpose.

When the peas have been shelled by means of these machines, they next are put through grading machines which sort out the different sizes. The very small peas which are thus obtained represent the immature ones, which would be of much larger size if harvested and packed at a later date. After grading the peas in the manner referred to, they are next parboiled or blanched and are then put upon zinc-lined tables. Here they are looked over by a force of girls, who pick out not only the occasional old peas or weed seeds that may have crept in, but also all broken peas. After this operation the peas are washed again and are then ready to go into cans.

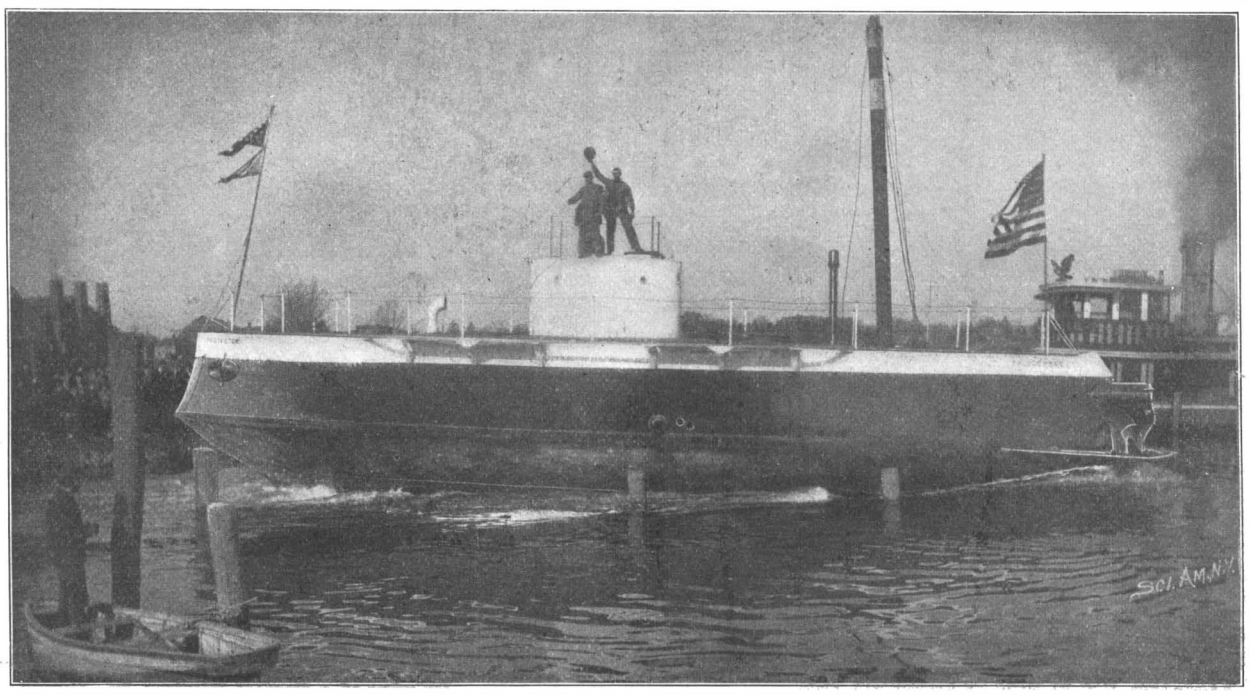
The filling of the cans is accomplished by means of machinery. Each machine fills twelve cans at one time. At the factory at Longmont 40,000 cans are filled in a day. After the cans are filled with peas a weak brine is added, and then the capping machines are put into service. These machines solder the caps on the cans at the rate of 40,000 per day. After capping, the cans are put into iron retorts; the lids of these retorts are bolted down, and the peas are cooked in the cans by means of steam. The labeling of the cans then takes place; this is accomplished by machinery.

In the line of agriculture, Longmont boasts, further, of the largest asparagus bed in the world. This bed comprises 120 acres and contains three-fourths of a million plants. The rows are about six feet apart, and the plants are 12 to 15 inches apart in the rows. The growing of asparagus of late has been attracting a great deal of attention throughout the United States. The Agricultural Department at Washington has been giving it especial attention, and has issued a bulletin to farmers dealing especially with asparagus culture. This bulletin is known as Farmers' Bulletin No. 61. At Long Island and New Jersey asparagus growing has been carried on for many years, but as the great West is being opened it admits of this cultivation upon a much larger scale than could be carried on in the more thickly populated sections of the country. The accompanying photograph of the asparagus field at Longmont gives some idea of the extent of the industry and its employment of both teams and men.

As asparagus is grown to a greater or less extent in many parts of the world, and as it has been known since the early days of the Romans, there are many authorities in many lands who have written upon its culture, and widely diversified have been the methods outlined. There are to-day advocates of both deep and shallow planting. There is also a difference of opinion among growers as to the distance necessary between the plants. It is conceded that, as a rule, the rows should run north and south, so as to secure the full benefit of the sunshine. Loosening the soil at the bottom of the plants and placing manure about their roots has been largely abandoned while, instead, the tops are now given the bulk of attention.

The bulletin sent out from Washington contains many interesting points about asparagus, including its history, a few points of which we will epitomize: Asparagus was first known to the Romans as a medicinal plant. It then grew to a great size. Pliny was able to record spears of asparagus weighing three to the pound. The Gauls, Germans and Britons learned of its value from the Romans and engaged in its cultivation. In France, Holland, Germany and Hungary it was early gathered for the wealthy classes by the peasantry. The earliest settlers brought asparagus seed to America and found the soil and climate suitable. Besides Long Island, New Jersey, and Colorado, asparagus is now cultivated to quite an extent in the Mississippi valley and on the Pacific slope. The demand for asparagus to-day is greater than the supply.

One more agricultural novelty in Colorado demands attention. It is an 80-acre currant patch. As far as is known, this is the largest currant patch extant. It is situated like the asparagus bed at Longmont. In this currant patch there are 135,000 plants set out in rows seven feet apart. The plants are three and a half feet apart in the rows. One hundred and fifty hands, old and young, are employed at picking time. One and one-fourth cents per pound is paid for picking, which enables expert pickers to make as high as $2.50 per day. A currant bush in Colorado will produce at least a gallon of currants. Some produce 10 gallons. Owing to irrigation, it is claimed that the berries are superior in flavor to those grown under other conditions.



LAUNCH OF THE SUBMARINE BOAT "PROTECTOR."

THE SUBMARINE BOAT "PROTECTOR."

BY WALDON FAWCETT.

The submarine torpedo boat "Protector," which was recently launched at Bridgeport, Conn., and is now nearing completion, is the invention of Mr. Simon Lake, who has been a student of underwater navigation for over twenty years. His first experimental undertaking in the field was made with a vessel only fourteen feet long, but in which three men remained submerged at one time for the interval of one hour and fifteen minutes. Later he built the "Argonaut," which served to first bring Mr. Lake's inventions to widespread public attention. The "Argonaut" as originally constructed was only 36 feet in length; but after use in an experimental manner for about a year, the craft was enlarged to a length of 66 feet, with 10 feet beam and 120 tons displacement. This vessel has been in almost continuous use for wrecking and kindred operations for about three years past, and has traveled thousands of miles under her own power along the Atlantic coast, and in the Chesapeake and Delaware Bays and Long Island Sound.

During the Spanish-American war Mr. Lake sought to interest the United States government in his inventions, but was unsuccessful. However, of his own accord, he gave a most convincing demonstration of the practical usefulness of such a vessel for mining operations, by means of an exhibition with the "Argonaut" at the mine fields abreast of Fortress Monroe, Va., and as a result of this disclosure of the possibilities of the invention, the United States Navy Department encouraged the construction of the "Protector."

The "Protector," which is covered by more than two hundred patents, most of which are essentially basic, is in design radically dissimilar to any other submarine boat. The divergence in design is perhaps most noticeable in the hull, which, in the case of the "Protector," is shipshape instead of cigar-shaped. The "Protector" is about 70 feet in length, 11 feet beam, and, when submerged, will have a displacement of 170 tons. In the center of the upper deck of the boat is an elliptical conning tower protected by an armored sighting-hood.

The motive power of the boat is furnished by gasoline engines actuating twin screws, when running awash or on the surface, and by means of storage batteries when submerged. The facilities for gasoline storage give the vessel a steaming radius (on the surface) of over 1,500 miles. The surface speed of the vessel is eleven knots, and it is claimed that she can maintain a subsurface speed of seven knots under any conditions. The storage batteries for utilization for underwater propulsion may be recharged directly from the gasoline engines when the latter are engaged in propelling the boat on the surface.

The "Protector" may be operated submerged at the full speed of seven knots for three hours continuously, without recharging the storage batteries. The air tanks, charged at a pressure of 2,000 pounds to the square inch, are capable of supplying sufficient air to enable a crew of six men to remain submerged for sixty hours. Incidentally it may be noted that the head space in the hull is such as not to necessitate the maintenance of cramped positions by the members of the crew, and the sleeping quarters are very satisfactory, consisting of folding berths somewhat on the order of those with which the ordinary sleeping car is equipped.

The armament of the "Protector" will consist of three 18-inch Whitehead torpedoes, for the discharge of which she has three tubes, one being located on either side of the bow and the third in the stern. The submerging of the boat is accomplished by the same general plan adopted in other submarine craft—the admission of water to submerging tanks. When submerged, however, save for the armored sighting-hood, the boat has a reserve buoyancy, and in order to totally submerge it is necessary to employ the hydroplanes, of which there are two on either side of the vessel. In explanation of the action of these hydroplanes, it may be stated that when the hydroplanes are tipped, the force of the passing water upon the inclined surfaces bodily shoves the craft below the surface, while a horizontal rudder at the stern serves to preserve automatically the balance of the boat.

The vessel will be surprisingly speedy in its changes of station. To change from ordinary cruising condition to that of deck awash will require but three seconds, and an equal interval will suffice for submergence from the awash condition to the exposure of only the sighting-hood. Complete submergence may be accomplished in less than a minute. The "Protector" can, if desired, be sent to the bottom without any interruption of the operation of the batteries; but in all probability the plan to be usually followed will provide for the stoppage of the machinery. The actual descent will be accomplished either by the admission of water to the tanks or by drawing the vessel down by the use of wire cables attached to two anchors,

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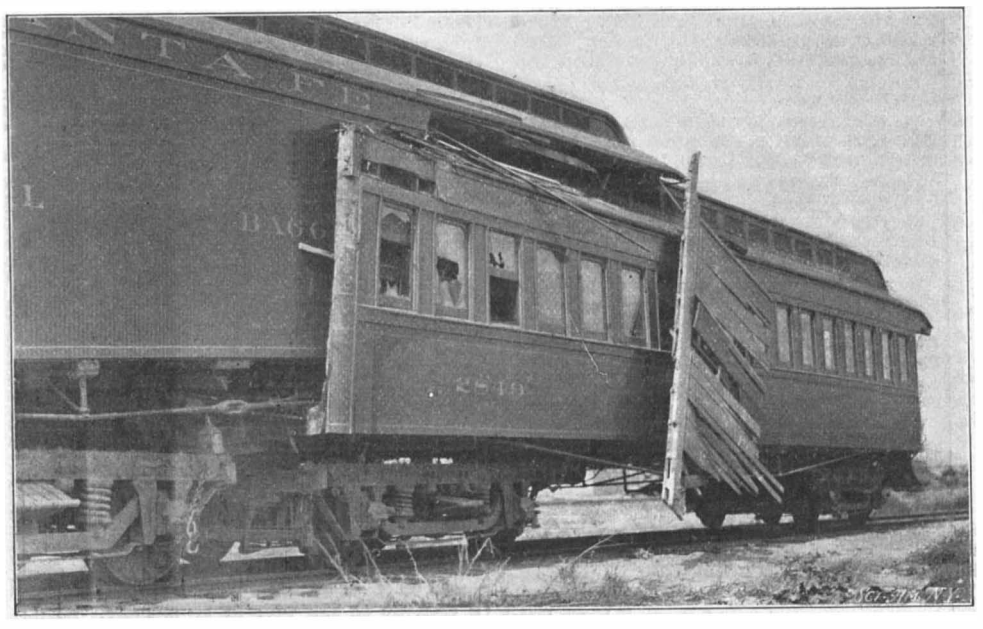
previously lowered to the ocean bed from anchor wells in the bottom of the boat. These anchors serve a double purpose, inasmuch as they, as well as a large section of the keel of the vessel, may, in the event of accident, be cast adrift, and the boat thus lightened will, of course, rise to the surface.

A unique feature of the Lake type of submarine boat is found in the fact that the craft is equipped for travel upon the bottom of the ocean, being fitted with two large steel wheels which are fitted on the keel line, one in advance of the other, and which may be raised or lowered at will. The propellers push the boat forward just as when she is afloat, but the wheels tend to keep the vessel upon a straight course, once the bearings have been taken. The "Protector" is also fitted with several other adjuncts which have not appeared in any other submarine craft, among the number being a device which indicates exactly the distance traveled on the bottom, and a telephone equipment which enables persons on the submerged vessel to communicate with those on shore. This would, of course, prove of advantage in war operations. The lines of the hull are such as to give the vessel a great reserve of buoyancy in every condition save that of total submergence upon the bottom, and this ability to secure absolute horizontal stability without imposing other than a reasonable movement of weights therein will it is claimed, enable the newcomer in the submarine field to be readily controlled in rough weather.

HEAD-ON COLLISION OF TRAINS IN LOS ANGELES, CAL.

The terrific effects of a head-on collision of trains, each running about twenty miles per hour, are shown in the accompanying illustrations. The accident occurred October 18 in Los Angeles, Cal., on the Southern California Railway. A northbound freight train of about twenty-five refrigerator, box and coal cars drawn by a ten-wheel locomotive collided with a string of eight passenger coaches drawn by a switching locomotive. The switching locomotive was in front of the string of coaches, but was running backward southbound. The engineer of the freight train was hurled back from his cab on to the tender, and his injuries may prove fatal. The other men in the train crews escaped without severe injuries. The trains carried no passengers.

The Locomotive of the Freight Train After the Collision.



The Forward End of the Passenger Train After the Collision.

HEAD-ON COLLISION OF TRAINS IN LOS ANGELES, CAL.

Burning Pulverized Coal.

The promises of economy gains from burning pulverized coal have for years led to persistently recurring experiments and each new venture in the field has been heralded with claims of final success. After all, however, experience in every instance seems to have ultimately demonstrated that it is difficult to obtain combustion of such fuel with as small an amount of air per pound of fuel as can be obtained in the best practice with coal fired on an ordinary grate, and this has always tended to make the economy lower than with the usual method. Besides this, the power required to operate the coal pulverizer and feeder has counted against the efficiency of the plant as a whole, and there is generally some difficulty from the collection of ashes and unconsumed particles of coal in the back connections of the boilers. Judging from all available data, these drawbacks still remain to be overcome.—Cassier's Magazine.

Gustave A. Barth, of Stapleton, S. I., has invented a very simple and convenient duplex wafer for fastening two sheets of paper together. The wafer is made in disk form and consists essentially of a many-ply body of paper, the layers of which are fastened together in the usual manner. The faces of the body are coated with an adhesive substance. It is simply necessary to moisten the coatings, to apply the wafer with one face to one of the sheets of paper, and then to press the second sheet upon the other face of the wafer in order to fasten the two sheets together. In separating the sheets of paper it is necessary only to pull the sheets apart, so that the body of the wafer separates along the division lines of the plies or layers. One ply with its coating will adhere to the one sheet and the other ply with its coating to the other.

The Successors of the Sea Serpent.

Ever since the sea serpent, which annually bobbed up in the newspapers during the dog days, disappeared in the depths of the ocean, apparently never again to trouble credulous readers, the imaginative reporter has drawn upon the animal kingdom for harrowing tales. Acting on the principle that a story is all the more credible if told with minute details, picturesque phenomena are described in lengthy accounts, in which, however, the name of the observing scientist, or of the particular spot where the observation was made, is never mentioned. Very often a foreign scientific journal is cited as the source of the writer's information. If an attempt be made to verify these fantastic descriptions, it is often found that the particular journal from which the information was supposed to be derived has no existence. For that reason the impression seems to prevail among journalists that a very large number of the most interesting occurrences in animal life are simply figments of the imagination.

An ingenious German writer has collated the accounts that have appeared in European papers, and gives us the results of his work in an entertaining article. The first animal that attracted his attention was the American turtle, which according to an imaginative reporter was subjected to a very rigorous examination, in order to show what an intellectual beast it was. The creature was made to thread a most intricate labyrinth in order to reach its food. The turtle was said not only to have succeeded in accomplishing this task, but even to have picked out the very shortest way to the trough. In a second and more difficult journey, the animal accidentally rolled down an incline. Ever since that accident the turtle insisted on rolling down the incline, simply because it found that the journey could thus be more quickly completed. To such a fantastical tale, a very serious journal devoted half a column, despite the fact that it constantly bemoaned the limited amount of space at its disposal.

The inhabitants of the watery element have also exercised a peculiar attraction upon the newspaper writer. Not long ago that sense of place which is said to be one of the most peculiar faculties of fishes was made the subject of a picturesque article. It was stated very positively that every salmon during the spawning season returns to the very brook in which it was itself hatched. Who was the observer of this interesting phenomenon is not stated. It was, however, very seriously asserted that "a scientist" had belted certain salmon with metal bands, and that these belted fish were found to return constantly to the brook where they were hatched. Doubtless the late Baron von Münchausen of blessed mendacious memory would enjoy these stories to the top of his bent. The critic in question states that it is hardly credible what good German burghers will swallow. Everybody knows that a salmon, after having attained a certain size, swims toward the sea, and returns to his old haunts only after he has increased his weight by several pounds. A metallic band fastened about him during the early stages of his growth would manifestly kill him.

Such stories have been published, not once, but many times. They recur at regular intervals, like the old mother-in-law jokes in the comic papers. The subjects most frequently treated in Europe are the large fish that weighs so many pounds that it takes many men to carry it; the old lady who knew Frederick the Great when she was a child; the faithful dog who was sold to some one who carried him off a hundred miles, and who returned with unerring instinct to his former master; the spider tamed by an imprisoned criminal (sometimes the spider is a fly); and the cat that defends her master's canary from the attacks of a rival cat.

It is perhaps pardonable to tell a few interesting lies of events that may have happened during the lifetime of a fictitious old lady. But the stories of animal life that figure so prominently just now both in American and European newspapers are sources of error often harder to eradicate than the tales of the living young to which the eel is said to give birth, or of the badger which is said to live from its own fat in winter-time.

Astronomical Problems.

Some time ago Prof. Darwin of Cambridge pointed out that if a star revolved on its axis with a certain velocity, that of a few hours, the star would tend to divide into two, and the form it would take before complete separation would be that of a dumb-bell, or rather two pears joined top to top. This deduction was purely theoretical. During the past two years an examination of the light changes of some recently discovered variable stars reveals this very condition of things. For example, one star in the southern sky goes through a certain regular series of light-changes in seven hours; and an examination of these light-changes indicates that the star is a twin system, the two bodies composing it being in contact. This dumb-bell system revolves round the common center in seven hours, the most absolute confirmation of the theoretical conclusions. Then there is another variable star in the southern sky the light-changes of which show that the two stars composing the system are no longer in contact, separation has just taken place, the nexus between them is broken, and two worlds, full born, have started on that outward spiral which in the course of ages will carry them far remote from one another.

The Scholer suction dredge "Nicolaus," which is working on the Kaiser Wilhelm Canal, is claimed to be a great improvement on the ordinary suction dredge. By using a head of peculiar construction on the suction pipe, the volume of water lifted with the dredged material can be regulated and limited to the minimum quantity required. This head is a closed receiver, into which the material is pushed, and into which the necessary amount of water can be admitted. The material and water are mechanically mixed in this receiver and then lifted by the pumps into hoppers of 400 cubic meters capacity. In working in compact soil, water under pressure can be admitted to the head to assist the excavator.

A patent case involving a thing no less important than a bung hole occupied the attention of the courts in Toledo, Ohio, recently. The decision was rendered in the case of Ulrich Ruedy against the Toledo Bushing Company, and decreed that the plaintiff was entitled to one-fifth interest in the invention for improving bung holes and bushing. The plaintiffs were instructed to assign Ruedy that portion of the profits.

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RECENTLY PATENTED INVENTIONS.

Plumbing Improvements.

FILTER ATTACHMENT.—W. T. ERICKSON, New York, N. Y. An improved filter is herein provided in which means are employed for reversing the flow of the water so that impure matter lodged in the filter may, from time to time, be washed out therefrom. The invention prevents the indiscriminate changing of the direction of the waterflow and at the same time provides means for effecting the change at the proper time.

FLOAT-VALVE.—J. L. MAYFIELD, Sonora, Texas. This float-valve is especially designed for troughs in which it is desirable to maintain a constant level of water. The valve will automatically operate to re-supply the tank with water when it is withdrawn to a certain lower level and will also operate to cut off the inflow when the water shall have reached a certain predetermined height in the trough, such as will be within easy reach of animals for drinking purposes, or the maintaining of a desired quantity of stored water.

Mechanical Devices.

BOTTLE-FILLING MACHINE.—S. C. MILLER, Louisville, Ky. In this invention a filling tank is employed and tubes depending therefrom enter the necks of a number of bottles. Means are provided for the escape of the air from the bottles as the liquid in graduated quantity is introduced within the bottles. The present invention is an improvement on a previous invention of Mr. Miller's, whereby the construction is rendered more efficient in service.

PNEUMATIC TOOL.—W. M. HOLDEN, Barre, Vt. Mr. Holden's pneumatic tool is arranged without a valve and the construction is such as to insure a uniform pressure on all sides of the piston and produce a free reciprocation with practically no friction. The tool is composed of but few parts not liable to get out of order and readily accessible to permit convenient cleaning or repairing whenever necessary.

DEVICE FOR WATERMARKING PAPER.—E. R. and O. F. BEHREND, Erie, Pa. By the use of this machine these inventors are able to secure a genuine water-mark by compression of the paper fibres in a paper-web while it is yet in a damp condition. Such compression of the fibres makes the water-mark take place after the paper-web has passed the couch rolls and before it enters the calenders.

BALING-PRESS.—M. CURRY, Killeen, Texas. Mr. Curry provides an improvement in that class of automatic presses adapted for baling hay, cotton, excelsior and similar materials. The materials are packed and compressed in the press box by means of a reciprocating plunger and wires are applied to the bale while being formed and subsequently twisted, knotted, and severed successively, after which the bale is ejected by the new one being formed.

Medical Apparatus.

THERMOMETER ATTACHMENT FOR FOUNTAIN-SYRINGES.—F. KING, New York, N. Y. The purpose of the invention is to provide a means for applying a thermometer to fountain syringes and similar containers in such manner that the scale of the thermometer may be conveniently read and the thermometer applied independent of the body of the receptacle, and yet in communication with its contents.

Railway Improvements.

DRAFT RIGGING.—P. M. CANTY Altoona, Pa. Mr. Canty's invention is an improvement in draft rigging for railway cars, and particularly in the means whereby the draw-bar is yieldingly connected with the car so it can yield longitudinally to a limited extent in both directions, and thus cushion the longitudinal strains on the bar.

Miscellaneous Inventions.

FLOATING FISH-TRAP.—A. C. BURDICK, Portland, Ore. The purpose of the invention is to provide a novel construction of floating fish-trap made especially to fish with the tide and further to provide a novel construction of the pot and first heart and means for flexibly and removably connecting them with supporting scows.

TUCK-COMB.—J. A. STILES, Wichita, Kans. The comb comprises two members having peculiar hinged-like connection. One member may be in the shape of an ordinary comb, and the other member having ornamental configuration. The main feature of the invention resides in so connecting the two members that after the comb-like member is introduced in the hair the two members will clamp it, and at the same time afford means whereby straggling hair may be secured.

FOLDING SATCHEL.—J. TREVETHAN, Berkeley, Cal. This metallic satchel or holder is designed especially for carrying books and is constructed to fold compactly when empty and to fold in close engagement at its sides with the outer side surfaces of the book covers when the device is carried or held in the hand.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 3403.—For manufacturers of automatic boot-cleaning machines.

Small Steam Motors. F. G. Grove, Luray, Va.

Inquiry No. 3404.—For machinery for pressing peat to be used as fuel.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 3405.—For machinery and supplies for a canning factory.

Dies, tools, models. Am. Hardware Co., Ottawa, Ill.

Inquiry No. 3406.—For machinery for removing the skin of animals after slaughtering.

Coin-operated machines. Willard, 284 Clarkson St., Brooklyn.

Inquiry No. 3407.—For makers of thermometers with circular dial faces.

Dies, stampings, specialties. L. B. Baker Mfg. Co., Racine, Wis.

Inquiry No. 3408.—For 3-inch steel tubing ¼ inch thick, finished on the inside, suitable for gas engine cylinders.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 3409.—For information concerning wireless telegraphy.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3410.—For machinery for plaiting rotted poplar or wah-hoo bark for making bark horse collars.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 3411.—For machinery for making scales on boxwood rulers.

Parties to manufacture on royalty the latest improved cooking range. Mrs. Eleanor Clarke, Emlenton, Pa.

Inquiry No. 3412.—For machinery and appliances for a cold storage room.

We make anything in sheet metal, any shape. Estimates free. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 3413.—For sheet metal model makers in New York and Philadelphia.

Inventions developed and perfected. Designing and machine work. Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 3414.—For manufacturers of machinery for making pressed brick.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3415.—For machines for affixing stamps to envelops or cards.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 3416.—For makers of malleable iron to do noveity work.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 3417.—For parties engaged in cutting small cones to order.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 3418.—For makers of headed wire pins (tempered) for perforating machines.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $5. Munn & Co., publishers, 361 Broadway, N.Y.

Inquiry No. 3419.—For manufacturers of axle cutters.

We manufacture on contract: patented hardware specialties, tools, dies, metal stampings, special machinery, etc. Edmonds-Metzel Mfg. Co., 778 West Lake Street, Chicago.

Inquiry No. 3420.—For manufacturers of glass bottles holding 5 quarts to the gallon, for carbonated spring water.

Gasoline Automobile Batteries. William Roche's "Autogas" used properly will carry vehicle twice as far as any other battery of same weight. William Roche, inventor and manufacturer, 42 Vesey Street, New York, N. Y., U. S. A.

Inquiry No. 3421.—For dealers in old rubber.

MONEY MADE EASY.—If you are employed in any branch of the electrical business, and want to increase your income in an easy and pleasant way, don't fail to *write us at once.* Our proposition is positively a necessity to all interested in the science of electricity. Address Frederick J. Drake & Co., 356 Dearborn Street, Chicago, Ill.

Inquiry No. 3422.—For makers of heaters using wood for fuel.

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Inquiry No. 3423.—For photographic nickel-in-the-slot machines.

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Inquiry No. 3424.—For makers of molds for making soap.

Inquiry No. 3425.—For manufacturers of engraving machinery for button making.

Inquiry No. 3426.—For makers of portable sawmills.

Inquiry No. 3427.—For makers of small clamps for paper.

Inquiry No. 3428.—For steel framing, girders, etc., for the construction of buildings.

Inquiry No. 3429.—For makers of appliances for distributing a dry powder fire extinguisher on fires.

Inquiry No. 3430.—For an ice machine, capacity 300 pounds per day.

Inquiry No. 3431.—For parties to manufacture patent cutlery.

Inquiry No. 3432.—For makers of hand and steam laundry machinery.

Inquiry No. 3433.—For information relative to the use of compressed air for elevating water from deep wells.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(8747) F. A. S. asks for a strong glue that can be held over a flame and then be applied. A. Some of the so-called marine glues are used in this way: (A) Naptha, 1 pint; pure rubber, cut into shreds, 1 ounce. Macerate for 10 to 12 days and then rub out smooth on a plate. Then mix 2 parts of shellac with 1 part of this solution. Melt at about 250 deg. F. for use. (B) Dissolve 10 parts of caoutchouc in 12 parts of refined petroleum, by digesting for 10 days to 2 weeks. Then carefully melt 20 parts asphalt and when melted, pour in the other solution. Keep warm (in hot water), and stir until uniform. Pour into greased molds and allow to harden. These marine glues are very strong.

(8748) G. H. M. asks: Can a battery be made where one of the electrodes used is gold? If so, what is the other electrode, and what is the exciting fluid used? A. We can see no reason why a battery may not be made with gold for a negative element, and any metal which will be acted upon by the liquid used for the positive element, if one wished to do so. Platinum was used in this way in some of the older forms of cell. It was replaced by carbon as a cheaper material. And the carbon of almost any cell may be replaced by gold.

(8749) J. M. C. asks: How many watts are required to 16 candle power incandescent lamp per hour? Also, about the average price per thousand watts of electricity. A. Incandescent lamps for best service are made for about 3½ watts per candle, or 55 watts for a 16 candle power lamp. The price for service is differently rated in different places. In large cities it is about 2 cents per ampere hour at 110 volts; in small places the rate is often so much a lamp-month, the time of lighting not being considered.

(8750) C. B. says: I want a magnetic coil capable of attracting an armature a distance of ¾ of an inch. The circuit will have a pressure of 110 volts at 10 amperes. What size coil will I need, and also size wire? A. We do not advise you to make a magnet as you propose to carry 10 amperes at 110 volts pressure for the purpose of attracting an armature ¾ of an inch. It would require a large wire and be very heavy. It is far better to use one ampere and have a pair of 100-volt lamps in parallel as a resistance. The coil will require to be wound to 10 ohms resistance and No. 24 wire may be used. Of this about 400 feet will be required.

(8751) C. S. N. writes: 1. Having noticed in your Notes and Queries column a short time ago that borax and good management are the best for welding steel, I wish to state that while both are indispensable, I find that an ounce of carbonate of iron to the pound of borax is a very good addition. Can you inform me whether aluminium can be soldered with lead-and-tin solder, and in what proportions? Also, what kind of acid to use? A. Lead-and-tin solder alone is not suitable for soldering aluminium. A solder made of 1 part aluminium, 1 part of 10 per cent phosphor tin, 8 parts zinc, 32 parts tin, by weight, makes a good-flowing solder. Canada balsam is used for flux. 2. What is the voltage of an Edison-Lalande battery cell, such as is used on gasoline engines, and will it be either temporarily or permanently exhausted by running a small motor for an hour or more? A. The voltage of an Edison-Lalande cell is about 7-10 volt. Their small internal resistance greatly increases their amperage and capacity to from 100 to 300 hours. They are not exhausted on short runs.

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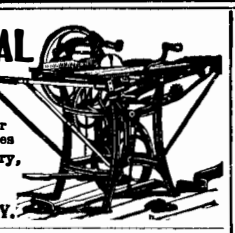

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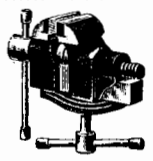

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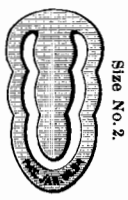

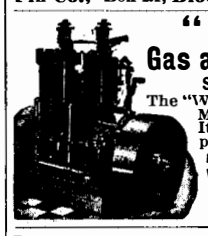

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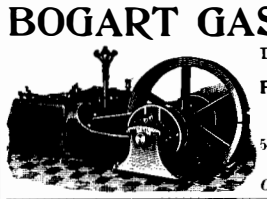

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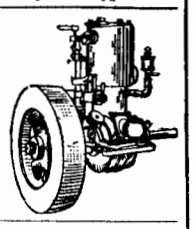

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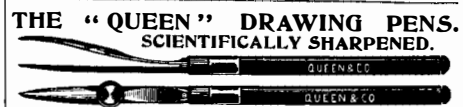

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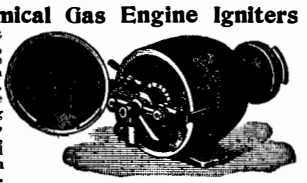

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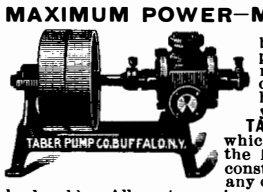

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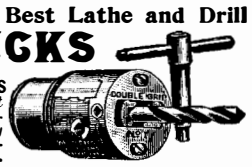

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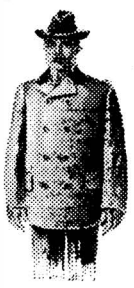

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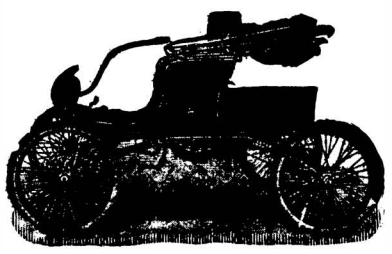

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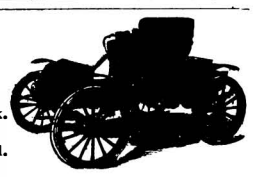

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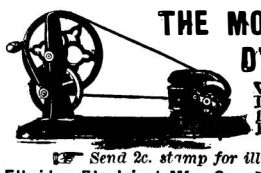

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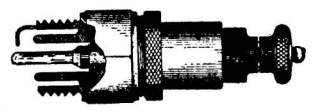

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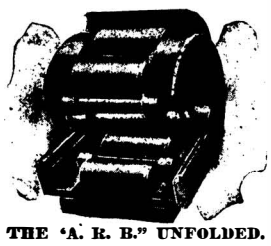

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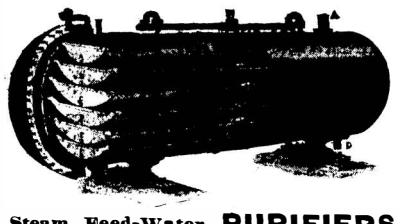

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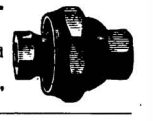

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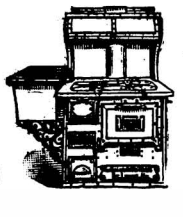

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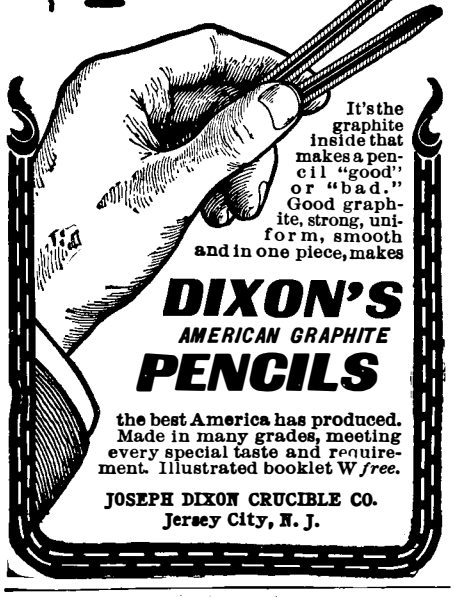

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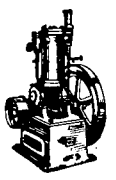

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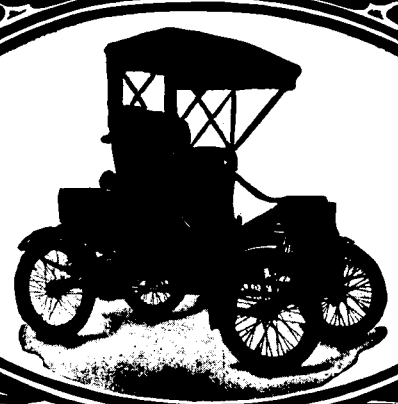

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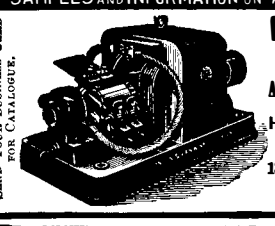

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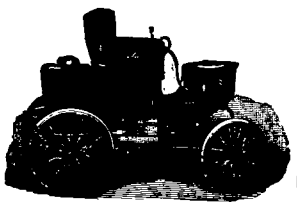

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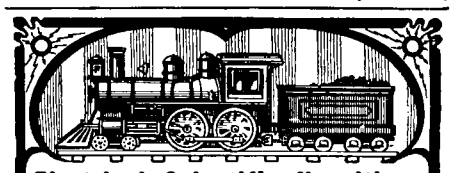

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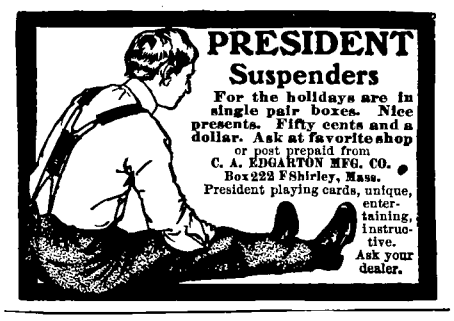

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